CANADIAN OCCUPATIONS

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CAREERS IN CONSTRUCTION

MONOGRAPH 41

DEPARTMENT OF LABOUR, CANADA

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DEPARTMENT OF LABOUR, CANADA

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FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The staff of the Occupational Analysis Section has prepared this series with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1957.

PREFACE

Careers in Construction has been written to give an over-all view of occupations in the construction industry — an industry which has played so vital a role in the post-war Canadian economy. It outlines the nature of the industry, the composition of the work force, and describes the work performed. Particular attention is given to on-site construction workers.

The booklet is intended to complement previous monographs dealing with specific building trades — Carpenter, Bricklayers and Stone-Masons, Plasterer, Painter, Plumber, Sheet-Metal Worker and Electrician. Readers wishing more detailed information on individual trades are therefore referred to previous titles in the "Canadian Occupations" series, which are listed on the inside back cover.

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Photo: N.F.B.

. . . where trading posts once stood.

HISTORY AND IMPORTANCE

Construction is Basic to Our Whole Economy

It is impossible to envisage our present way of life without considering the work of the builders, past and present. The structures and engineering projects that represent our progress and prosperity are constant reminders of construction's important position in the national economy. Spacious apartments, comfortable homes and handsome public buildings provide the amenities for modern living. Highways, bridges, railways and docks provide the necessary

facilities for fast, efficient transportation and the distribution of goods. Dams harness water power for hydro-electricity to light our cities and power our factories. The development of our natural resources and the conquest of natural barriers is, to a great extent, in the hands of the builders.

It is reasonable to expect that in a young and growing country such as Canada the work of construction will assume unusual importance, and it is a fact that tremendous post-war expansion has been marked by a boom in the construction industry. The value of total construction has risen to an expected $6 billion for 1956 from about $2 billion in 1947. Construction is accounting for an increasing percentage of the Gross National Product, having risen to nearly 20 per cent in 1955 from 14.6 per cent in 1947.* In addition, the beneficial effects of construction activity are passed on to many other industries, primary and secondary.

The Need for Apprentices

The high level of construction activity has made heavy demands on the country's manpower. In 1946 the industry employed about 228,000. In 1955—a record year for construction—the peak month showed about 432,000 persons working in the industry. This means that about 8 per cent of the labour force, or approximately one worker out of every twelve, was engaged in the construction industry.

The growing complexity of many construction operations and the increased volume of work have naturally been accompanied by a demand for more highly skilled technicians and professional engineers. The mechanical and electrical trades have, for example, undergone many developments in recent years and the introduction of atomic power will undoubtedly present for them new and technically difficult installation and maintenance problems.

A relative shortage of well trained men in the skilled construction trades is a problem in most parts of the country. In periods of rapid economic expansion, such as the early 1900's, the 1920's, and again during the last ten years, Canada has relied heavily on immigration as a source of highly trained workers. In the decade 1946-55, some 45,000 immigrants came to Canada as skilled construction workers compared with apprenticeship completions in the building trades of 15,000 to 17,000—a ratio of three to one.

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*D.B.S. *Construction in Canada 1954-56* (expressed in current dollar values).

It is not likely that we can continue to rely on the immigration of skilled tradesmen to fill the needs of an expanding construction industry, as many of the countries from which the bulk of our immigrants have come are now experiencing their own shortages of skilled manpower. The industry will therefore have to look to Canadian youth to insure an adequate supply of young apprentices for the basic building trades.

Building — Past and Present

The history of building is lost in antiquity. Prehistoric man, like the aborigines of today, probably constructed his home with the materials at hand. Smearing the walls of his reed home with mud to make it weather proof was probably the beginning of plastering. We know the ancient Egyptians plastered the walls of their tombs three to four thousand years ago, leaving behind the trowels used in the trade. Bricks of mud, dried in the sun, gave rise to the bricklayer's trade. The discovery and use of metal provided edged tools to shape wood and stone for building purposes and led to the development of carpenters and stone-masons. Other uses for metal led to the growth of plumbers, who used lead (plumbum) for their pipes, and sheet-metal workers—tinsmiths or coppersmiths, as they were called. In more recent times the discovery and use of electricity called for a new group of tradesmen, known as electricians, to install wire and fixtures for electric light and power.

These trades are still the important elements in all building construction, but with the development of new materials and building techniques there is a trend towards specialization within some trades for certain aspects of the work. As a result, technicians with additional skill and knowledge are now required to install complex, electrically controlled air conditioning and heating units, refrigeration units, sprinkler systems, etc.

In addition to the protection against the elements which his home gave him, man needed protection against his enemies. Construction of fortifications, and of roads and bridges for military purposes, gave rise to a group known as military engineers. The Great Wall of China, and traces of old Roman roads and fortifications are evidence of early military engineering, and engineers are still an important group in modern armies. Early engineering was accomplished by the hand labour of thousands of workers, usually slaves, assisted by horses, oxen, and other beasts of burden. Time was less important then, and some projects took many years.

Since the invention of steam power, and later the internal-combustion engine and the electric motor, heavy construction has undergone a remarkable revolution. The use of heavy powered equipment now makes possible the excavation, removal and installation of masses of material speedily and without the arduous labour of pick-and-shovel gangs.

Construction in Canada

Early explorers found Canada undeveloped but rich in potential. It was a land in which to build a nation. Some 350 years ago Champlain and his associates built Port Royal, "a beautiful settlement in a great quadrangle of spacious houses of fragrant logs", marking, if not the first, at least the early beginning of the white man's construction in Canada.

Photo: N.F.B.

Dams harness power for industry.

At the outset, the geography and climate of Canada presented difficult problems in construction. It has been necessary for a thinly scattered population to cope with such difficulties as rugged mountains, broad rivers, muskeg, permafrost, extreme winter conditions and isolation. In the years that have followed the early settlement, however, a modern nation has been carved out of the wilderness. Great cities sprawl where small trading posts once stood. The gigantic task of linking the nearly 4,000 miles between the east and west coasts with a railway was one of the major engineering accomplishments of the newly federated provinces.

The post-war period has seen tremendous strides in construction—the building of over one million housing units, at a cost of $8 billion; development of the Quebec-Labrador iron ore deposits and the building of a 358-mile railway from Seven Islands, one of the biggest railway construction jobs since the C.P.R. was blasted through the Rockies; the aluminum extracting plant and power project at Kitimat and the Bersimis power project in Quebec; the ambitious St. Lawrence Seaway and Power project, so long a dream of the visionaries—these are only a few of the countless projects that have been completed or are under way. Construction is thus changing the face of Canada.

NATURE OF THE INDUSTRY

Construction is carried on in every section of the country, and most construction firms are entirely local in their operations. The larger firms' offices are naturally in the larger cities, and it is not uncommon for them to compete for projects hundreds of miles away.

A substantial amount of minor building and construction work is done by individuals working by themselves or with a few men, such as farmers erecting their own barns, and private individuals building their own homes. Government departments and some large corporations also do construction and maintenance work for themselves with their own people. Approximately one-quarter of construction is done in this way.

The remaining three-quarters of construction work is carried out by contractors or builders. Many contractors carry out work in accordance with a set of plans and specifications for an individual client or owner. Other contractors build on the speculation that they will be able to sell or rent their projects. The speculative builders are mainly active in the erection of houses, apartment blocks and light commercial and industrial buildings.

Such developments as the use of steel and concrete, increasing specialization within the building trades, and the rise of new trades, led to the appearance of the general contractor. The general contractor assumes over-all responsibility for the construction of a project, places sub-contracts, and co-ordinates the work of the various trades, thus relieving the client of this onerous task.

Trade contractors specialize in the work of one or more trades such as painting, plumbing, bricklaying, plastering or electrical installation. They may obtain work by sub-contract from a general contractor, or directly from the owner, and take no responsibility for the structure as a whole.

There are two major divisions of activity in this industry—Building and Engineering Construction. Building covers all on-site work on residential, commercial, industrial, institutional and other building; engineering consists of work done on streets, highways,

Photo: N.F.B.

A million homes in a decade.

bridges, watermains, dams, reservoirs, central electric stations and transmission lines, docks and other engineering projects.

Building construction, particularly residential building, has dominated the Canadian scene for the last decade. The backlog of demand for housing, accentuated by a post-war increase of family formations, was met by a vigorous house-building program stimulated by the organization of the Central Mortgage and Housing Corporation under the National Housing Act of 1945. Before the war house-building had proceeded at the rate of only 38,000 units annually. Now, more than 100,000 families are moving into new homes each year. In 1955 a new house-building record was set, with over 143,000 dwellings started and over 131,000 units completed, including conversions.* Residential construction has accounted for approximately half of the building since 1953, the balance being made up of industrial, commercial, institutional and other building. Total building construction has accounted for approximately 60 per cent of all construction over the same period.

VALUE OF CONSTRUCTION WORK PERFORMED, BY PRINCIPAL TYPES OF CONSTRUCTION, 1955.†

	Value ($ Mill)	Per Cent of Total
TOTAL CONSTRUCTION	5,286	100.0
Total Building Construction	**3,374**	**63.8**
Residential	1,734	32.8
Industrial	409	7.7
Commercial	530	10.0
Institutional	461	8.7
Other	240	4.6
Total Engineering Construction	**1,912**	**36.2**
Marine Construction	77	1.5
Road, Highway & Aerodrome Const.	508	9.6
Water Works and Sewage Systems	182	3.4
Dams and Irrigation	30	0.6
Electric Power Construction	328	6.2
Railway, Telephone & Telegraph	311	5.9
Gas and Oil Facilities	310	5.9
Other Engineering Construction	166	3.1

*D.B.S. *Canadian Housing Statistics* 4th Quarter, 1955.

†D.B.S. *Construction in Canada, 1954-56.*

Photo: N.F.B.

Engineering Construction: Excavating for the Toronto Subway.

WORK FORCE OF THE INDUSTRY

It is obvious that an industry such as construction, which involves a wide variety of activities, must include workers of many levels of skill and many different occupations.

EMPLOYMENT IN THE CONSTRUCTION INDUSTRY BY OCCUPATIONAL GROUP, 1951.

	Number	Per Cent of Total
Construction Workes (on-site)	277,878	79.2
Owners and Managers	22,757	6.5
Clerical and Sales	12,244	3.5
Professional	5,710	1.6
Others	32,307	9.2
	350,896	100.0

Census of Canada 1951.

On-Site Construction Workers

The workers directly concerned with on-site construction are by far the largest group. These workers handle and put into place the material that goes into a construction project. In 1951, when the last census was taken, they numbered nearly 280,000, or about 80 per cent of the total number employed in the industry. A breakdown of on-site construction workers by trade is given in the following table:

DISTRIBUTION OF ON-SITE CONSTRUCTION WORKERS IN CONSTRUCTION INDUSTRY, 1951

	Number	Per Cent of Total
Brick and Stone Masons	13,723	4.9
Carpenters	86,260	31.0
Sheet-Metal Workers	3,246	1.2
Electricians and Wiremen	13,545	4.9
Painters, Decorators & Glaziers	27,000	9.7
Plasterers and Lathers	9,010	3.2
Plumbers and Pipe Fitters	18,860	6.8
Foremen (Construction)	10,456	3.8
Cement and Concrete Finishers	2,566	1.0
Construction Machinery Operators	6,518	2.3
Structural Iron Workers	1,147	*
Welders and Flame Cutters	1,596	*
Stationary Enginemen	4,371	1.5
Labourers	73,163	26.3
Other Construction Workers	6,417	2.3
Total	277,878	

Census of Canada 1951
*Less than 1 per cent.

Owners and Managers

The owners and managers, who conduct the business of construction, determine the policy and, in general, provide the leadership and risk capital necessary in construction operations, numbered 22,757 in 1951, about 6.5 per cent of the total number engaged in the industry. Although this figure includes contractors carrying out large-scale construction projects, there are also many small construction companies operating locally in every section of the country.

The large percentage in this group reveals the opportunities that exist in this industry to become independent in one's own business.

Clerical and Sales Workers

The construction industry also requires a staff of clerical workers such as bookkeepers, timekeepers, stenographers, shipping and receiving clerks, typists and filing clerks. Female clerical workers, numbering 4,613 in 1951, represent the only sizable group of female workers in the industry. Construction is still primarily a man's job. In addition to clerical workers, the business of construction requires sales representatives, purchasing agents and buyers, agents and appraisers. The entire clerical and sales group totalled 12,244, or 3.5 per cent of the industry's work force.

Professional Workers

Although not large in numbers (5,710 in 1951), professional workers and their technical assistants perform an essential service for the industry. In addition to architects and engineering specialists, there are accountants and auditors, estimators, surveyors, draughtsman and designers, chemists and metallurgists, laboratory technicians and others. The work is highly technical and usually requires a long period of training and experience. Many of these occupations have been covered individually in monographs in the "Canadian Occupations" series, a list of which may be found on the inside cover of this booklet.

Other Workers in the Construction Industry

About 32,000 persons were employed in 1951 to perform a wide variety of miscellaneous services in the construction industry. Included in this group are mechanics of various types, quarriers and rock drillers, stone cutters and dressers, cabinet and furniture makers, truck drivers and motor mechanics. Special tradesmen such as millwrights, machinists, blacksmiths, machine operators, tool makers and filers are required to maintain and repair machines used in construction work. Guards and watchmen are necessary to protect projects under way.

WORK PERFORMED

On projects of any size, workmen are usually organized into crews or gangs, each headed by a *foreman* who has the necessary background and experience in the job, and who has the ability to organize and direct the work of the men under him. In the case of crews of skilled tradesmen, the foreman will be a journeyman or master craftsman. The foreman is responsible to the *general foreman* who co-ordinates the work of the entire project under the supervision of the *superintendent*. Crews are usually designated by the type of work in which they are engaged, the material they work with, or by the machine they operate, e.g., cement batching-and-mixing plant workers, structural steel workers, crane and derrick crews, or pile driver crews.

Planning

The first stage of any construction work is that of planning. The owner's requirements are interpreted by *architects* and/or *engineers*, and plans, in the form of drawings, are prepared by *draughtsmen*. Attention must be given not only to the owner's requests but also to local building by-laws and provincial regulations concerning material standards, loads and stresses, adequate light, exits, fire-doors, etc. Information concerning sub-soil condition, rock formations and topographical features affecting the proposed project, particularly if it is a large one, is obtained from reports by *geologists* and *surveyors*. On the basis of all this information, tenders are invited from *contractors* who may bid for the contract to do the actual construction. An important part is played by the contractor's *estimators*, who have to estimate the cost of the project in terms of labour and material. When the tender is accepted and a contract signed, the contractor proceeds to organize men, machinery and material, arrange for sub-contract work where necessary, and get the project under way.

Site Preparation and Excavation

In order to prepare a site for construction, trees, undergrowth, rock or existing structures must first be removed. *Bulldozer operators* push trees, roots, boulders and other material away from the site, and *grader operators* level the work area. Existing structures may be demolished by *wreckers* assisted by *crane operators* operating

cranes which shatter walls and foundations by swinging heavy iron weights against them.

Some structures may be removed intact by *removal crews* who jack them up and haul them away on rollers. In the St. Lawrence Seaway and Power project, the re-location of whole communities lying in areas to be flooded has been a major undertaking.

Some excavations are made which form an actual part of the project, such as canals and reservoirs. Other excavations are made to remove the overburden covering the bed rock and to make way for the laying of foundations. Most excavation and grading is now done by men operating various types of earth-moving equipment, ranging from small bulldozers and overhead loaders to giant power-shovels, power-scrapers, and graders. Power-shovels scoop up loose rock and soil and load it into waiting dump trucks or tractor-drawn trailers which carry it away. Where solid rock is encountered, it must be blasted loose by *blasting crews.* Water entering the excavation must be pumped out, sometimes requiring the installation of a cofferdam to prevent further flooding. *Carpenters* may have to erect supporting timbers or steel sheet pilings to prevent cave-ins.

Footings and Foundations

A footing is an enlargement at the bottom of a wall, pier or column to distribute the load of the structure, and to prevent settling. If the ground is soft, columns of timber or steel, called pilings, driven to a solid bearing by a pile driver, furnish the necessary footing. *Pile driving crews* consist of a *foreman* (*pile driving*), *pile driver operator*, and *helpers* who set the pile driver into place, line up the pilings, and dismantle or move the machine on completion of the work.

Concrete is used extensively in many construction projects to form footings, foundations, pilings, walls, floors and columns. Forms are required to give the poured concrete its shape and to support it while it hardens. Forms may be of wood, sheet-metal or steel, and are installed by carpenters known as *form setters.* The *foreman* (*form carpentry*) determines from the blueprints where the forms are to be placed, consults with the superintendent to decide the order in which the forms are to be built and the placement of the chutes down which the concrete must be poured, and supervises the work of *carpenters* (*form building*) and their helpers.

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BUILDING

Excavation

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Foundations

Photos: Public Wo

IN
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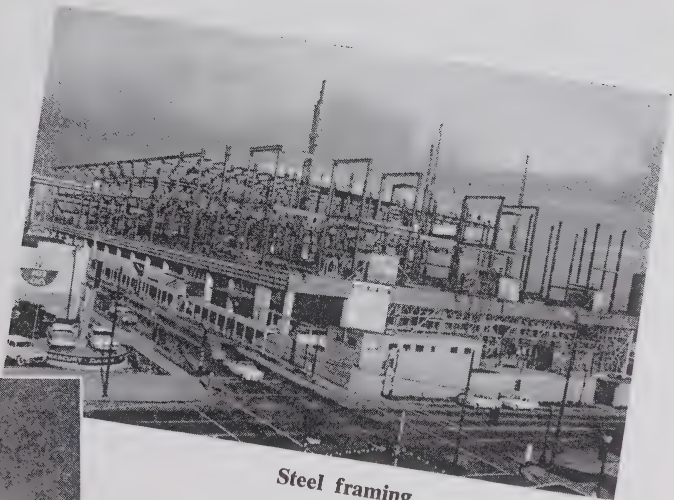
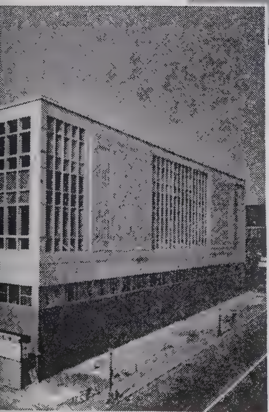


Steel framing



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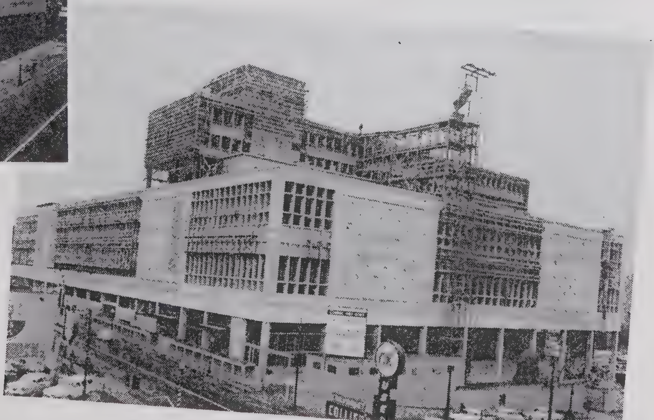

Exterior finishing

artment, Ottawa.

In reinforced concrete, steel rods or mesh must be secured into place within the forms to give the concrete added strength. This work is done by *rodmen*. The *foreman* (*rodman*), following blueprints, directs and supervises workmen in placing and wiring steel rods. *Form strippers* remove the forms after the concrete has hardened.

As a rule, ready-mixed concrete is obtained from commercial suppliers. In some projects, owing to the remoteness from suppliers, concrete is mixed on-site in concrete mixing-and-batching plants. The concrete is delivered from the mixing plant by means of trucks or piped under pressure directly to where it is required. It may be poured into the forms by chutes, or by *concrete-gun operators* who force the concrete into all parts of the form. *Vibrator operators* tamp the concrete with vibrators to pack it and remove air bubbles; *concrete finishers* level off the top of the pour. The *foreman* (*concreting*) directs the workmen and inspects the completed work.

Framing

This and the following stages of construction are limited mainly to building projects and do not ordinarily enter into engineering projects such as dams and canals. Construction of steel bridges and transmission towers does, however, include a stage similar to structural steel framing which is outlined below.

The term framing is generally applied to the work of *frame carpenters* in connection with residential and light wood construction. These carpenters lay wooden sills on the foundation, on which the floor joists rest; lay subflooring; erect the studs for siding and walls, and complete the roof frame.

Framing for large buildings calls for engineering skill and the specialized knowledge of many different workers. The materials used must be able to carry tremendous weights. Structural steel, reinforced concrete, or combinations of both, and more recently, reinforced concrete pre-cast into beams and girders, are common framing materials.

In steel framing, steel members such as girders, rafters, trusses and braces, fabricated according to specifications in a steel fabricating plant, are brought to the construction site by trucks or railway cars. They are unloaded and hoisted into position by *cranemen*. *Structural steel workers* bolt them temporarily into place and align them, after which they are welded securely by *welders*, or riveted together

by *riveters*. Riveting crews consist of a *foreman* (*rivet pusher*); a *rivet heater*, who heats the rivet in a small forge and tosses it to a *rivet catcher*; a *bucker-up*, who holds the rivet in place, and a *riveter*, who hammers down the rivet shank with an air-driven riveting hammer. Structural steel workers are probably the most colourful of the construction workers, as they clamber about with unconcerned ease, high above street level.

In reinforced concrete framing, the upright columns, the floor girders and beams, and the roof supports, are made of reinforced concrete poured into forms or moulds and allowed to harden. Floors and roof slabs may also be formed in this way. Form carpenters build the necessary forms, steel reinforcing bars are wired into place by rodmen, and concrete is poured into the forms and allowed to harden.

Exterior Finishing and Roofing

The exteriors of modern buildings serve primarily as a protective curtain against the elements and for ornamental effect, rather than as strong, weight-bearing walls. This allows for a wide selection of materials to finish the frame. Common finishing materials used are wood, stone, brick or marble veneer, glass, plastic or sheet-metal, and rough cast (stucco). The material used will determine whether *carpenters*, *bricklayers*, *stone-masons*, *sheet-metal workers* or *plasterers* apply it.

When the exterior walls are completed and the openings are framed, sashes of metal or wood are installed. *Caulkers* fill in the crevices with oakum (rope fibre) and caulking compound. Window sashes are usually supplied already glazed, otherwise *glaziers* cut sheets of glass to size and cement them into place with putty. Large plate glass windows may be installed by the manufacturer, and are secured by means of metal moulding strips screwed to the window frame.

On completion of the roof framing, carpenters lay wood sheathing on the framework. *Roofers* nail on overlapping shingles of asphalt composition, wood, slate, tile or terra cotta. They cut and shape sheet-metal to make waterproof gutters in roof valleys and flashing against chimneys. Flat roofs are made of alternate layers of tar paper and melted tar, coated on top with sand or small pebbles.

Electric Wiring, Plumbing and Insulation

Before the interior walls are put in, *electricians* position electrical conduits, outlets, and switches, according to blueprint specifications, and complete the wiring to fuse boxes and panels. The installation of fixtures takes place after the interior walls are finished.

Arrangements for heating, water supply, drainage and plumbing fixtures are specified by blueprint. *Plumbers* cut, thread and install the various pipes and valves, make the necessary connections with water mains and sewers, and install some of the fixtures. When the interior walls are finished, the rest of the plumbing installation is completed.

In order to reduce heating costs, eliminate drafts and neutralize the effect of extreme temperature changes, crevices and spaces in the outside walls and attic ceilings must be filled with insulating material. *Insulation workers* staple bats of rockwool or fibre glass between vertical wall studs and between ceiling rafters, or blow loose insulation material into the spaces.

Special Installations

Modern building requirements go beyond the standard electrical and plumbing facilities. Automatic heat control and air conditioning equipment, involving multiple thermostat controls, mechanical and electronic switching and cut-out panels, must be installed and brought into operating balance by highly trained *technicians*. Special installations for heavy electrically powered equipment or for inter-office communications are also done by specialists.

Interior Finishing

The traditional interior wall finish has been plaster, or, in more ornate homes and buildings, wood panelling, tile or marble. Recent developments in plywood and "dry wall" composition or plaster board have made available new and different finishes for the interiors of buildings.

Wood lath, once commonly used as a base on which to apply plaster, has given way to metal lath and plasterboard. *Lathers* nail on the plasterboard or metal lath which forms the base to which the plaster adheres, and reinforce all inside corners and points of stress with strips of wire mesh to prevent cracking. *Plasterers*

prepare all protruding corners with corner bead to prevent the plaster from being chipped or broken off, then apply two or three coats of plaster to finish the walls. Moulded cornices may be added to walls and ceiling for decorative effect.

Floors may be covered by carpenters who specialize in laying floors of soft or hard wood, nailing it to the subfloor boards. *Floor finishers* sand the newly laid floor and apply protective coats of wax or varnish after final painting and decorating is completed.

Other materials used for flooring are tile, terrazzo, linoleum, asphalt, concrete or even brick. *Tile setters*, using various types of mortar, cement or glue, place linoleum, asphalt, plastic, rubber or marble tile in pre-arranged patterns on the smooth surface of the subflooring. *Terrazzo layers* spread a mixture of cement, sand and marble chips smoothly over the concrete subfloor. When the terrazzo has hardened, it is ground and polished smooth with a floor surfacing machine.

Finish carpenters, skilled at fine work, complete the details of wood work such as stairs, moulding, cupboards, panelling, doors and windows.

Final work to the building is done by *painters* and *decorators* who apply paints and varnishes with brush, roller or spray gun, according to a pre-determined colour scheme. Wall paper may be applied by *paper hangers*. *Ornamental iron workers* may add decorative iron railings, columns, stairs or gates.

Some large buildings require additional fixtures such as elevators, escalators, water tanks, sprinkler systems, and refrigerated storage rooms, which may be installed by the manufacturers or by special crews of technicians.

Engineering Construction Work

About one-third of the construction work carried on is included under the heading of engineering construction. Typical projects include marine construction, such as docks and harbour facilities; road, highway and aerodrome construction; waterworks and sewage disposal systems; dams and irrigation; electric power construction, such as transmission lines and power stations; railway, telephone and telegraph; and gas and oil facilities, such as refineries and pipe lines.

Because of the diversity of engineering construction, techniques vary considerably according to the project. Handling of material in bulk quantities requires the extensive use of powered equipment, hence the employment of many skilled equipment operators on most projects.

In marine construction, where work is complicated by the presence of water, vessels such as barges, tugboats and derrick boats, manned by *captains*, *mates* and *crews*, in addition to *stevedores* and *divers*, assist in operations. *Dredging crews* and *caisson workers* are also unique to marine construction.

Highway construction consists mainly of excavation and grading work, carried out by operators of bulldozers, scrapers, graders, power shovels, tractors and dump trucks. Paving is done by *concrete workers*, *asphalt tampers*, *smoothers and spreaders*, and *paving machine operators*.

Photo: P.W.D., Ottawa.

Paving a section of the Trans-Canada Highway.

Pipe line laying, which is becoming an important aspect of the petroleum industry, includes operators of mechanical trenchers, *pipe line welders*, and industrial *X-ray technicians* in its construction crews.

QUALIFICATIONS

The field of construction work is sufficiently varied to offer congenial employment to people of widely varrying personal qualifications. It is therefore difficult to lay down specific qualifications which are typically required of those thinking of entering the field. There are, however, certain characteristics desirable in those who are interested in on-site construction work.

The construction industry needs keen, intelligent, ambitious men who can train for the highly technical jobs which exist in this field today.

Good health and a sturdy constitution are essential, as the work, especially for the beginner, may be strenuous, and much of it performed outdoors or in unheated buildings.

Those who like to work with their hands, and who have an interest in building, will find scope for the exercise of craftsmanship and artistry in many of the skilled trades. Manual training classes and school shop courses offer an excellent opportunity to explore one's ability and interest in working with tools. Important also is the ability to visualize a completed project from a plan, sketch or oral instruction.

The increasing use of powered tools and equipment in construction work requires a good degree of mechanical aptitude. The ability to adapt to new working conditions, new materials and equipment is important in an industry which has been marked by rapid changes and developments.

Advancement in the field to foreman requires the ability to direct the work of others in addition to trade skill. A sound business background and organizing ability are necessary for those who hope to become managers or owners.

Those who like to see the concrete results of their work, who like to come to grips with tangible problems and solve them with direct action, should do well in construction work.

PREPARATION AND TRAINING

General

The best preparation for construction work is to get as much formal schooling as possible, including such subjects as shop mathematics, shop practice, draughting, blueprint reading, and science. These courses will lay the groundwork needed to master the technical details which will be encountered later on.

Many technical and vocational high schools offer courses in the basic building trades such as carpentry, electricity, plumbing, sheet-metal work and general shop courses. Time-credit on apprenticeship is usually allowed for training obtained in approved courses.

Apprenticeship Training

The traditional method of training for the building trades has been through apprenticeship. Most provinces in Canada have "designated" the building trades for apprenticeship and have placed the entry and training of persons in these trades under provincial regulation. The trades affected include bricklaying, carpentry, electrical installation, plumbing, painting, plastering and sheet-metal work.

The purpose of apprenticeship regulations is not to impede entry into the trade, but to encourage a good supply of suitable candidates, to maintain a uniform and high standard of training, and to admit only qualified tradesmen to journeyman status.

Apprenticeship consists of a period of on-the-job and classroom training lasting from three to five years. A written agreement, called an indenture, which is registered with the provincial Apprenticeship Board, specifies the obligations of the employer and the apprentice, the period of training, the hours to be worked, the wages to be paid and the increases to be given from time to time. In addition, the regulations govern the ratio of apprentices to journeymen under each employer or in certain areas, the minimum and maximum age of entry, educational requirements, and the amount of class instruction during apprenticeship.

The regulations vary among the different building trades, and from province to province, and are more fully dealt with in individual monographs in the "Canadian Occupations" series.

Generally speaking, minimum educational requirements are grade 8 or 9, although electricians may need grade 10 or 11. Those who wish to progress in the trades should, if possible, continue in school beyond the minimum required.

Under apprenticeship, the youth is given progressive training on the job under the guidance of a qualified journeyman. Class instruction augments the practical training and rounds out theoretical knowledge.

Class instruction may be full-time, lasting from one to three months during each year of apprenticeship, or part-time from four to six hours per week, and is given in provincial trades schools or municipal technical schools. Completion of the apprenticeship period and successful trade examination is rewarded with journeyman status.

Pre-apprenticeship Training

The value of trade training prior to apprenticeship was demonstrated after the close of World War II, when large numbers of returned veterans were prepared for apprenticeship in special classes lasting about six months. Similar classes are now being conducted in many of the provinces for prospective apprentices. A reduction in the apprenticeship period is usually allowed for such training.

Apprenticeship in Quebec

In Quebec, apprenticeship programs are conducted by Apprenticeship Commissions situated in various parts of the province, each of which controls apprenticeship in its own area. Apprentices are not ordinarily indentured to an employer, but they are required to register with the appropriate Apprenticeship Commission.

The beginner, if he chooses, may go directly into the trade and serve a four-year training period. However, an alternative way, and one which is encouraged by apprenticeship officials and employers, is for the prospective apprentice to first prepare himself in one of the pre-employment classes. These classes, provided at special schools conducted by Apprenticeship Commissions in Montreal, Sherbrooke, Chicoutimi, Hull and Quebec, are about six months in duration (ten months in Hull), and the time spent is applied to the apprenticeship period. Graduates of pre-employment classes usually start at higher rates of pay than those who do not have the benefit of previous training.

While working on the job, apprentices are encouraged to take evening instruction in classes operated by the Commissions, or in the regular provincial technical or vocational schools. Attendance at these classes may also shorten the apprenticeship period.

At the end of the apprenticeship training, all apprentices are trade tested, and if successful, are given a "Competency Card" denoting journeyman status.

Equipment Operators

Training for many jobs in construction such as the operation of tractors, bulldozers, power shovels, draglines, pneumatic drills, compressors and other mechanized tools is less formal and is shorter than in the traditional building trades.

Beginners who have shown the necessary interest and aptitude, or who have had related experience, are usually assigned as helpers to the equipment operator, under whose guidance they learn the job. Training may also be provided by the manufacturer of the equipment, the contractor, or by a master mechanic who has specialized training.

Construction equipment operators are often recruited from among those who have had previous car or truck-driving experience. Farm boys who have operated farm machinery such as tractors and combines often gravitate to these jobs.

On the other hand, operators of heavy power-generating plants may require journeyman electrician's papers, or a stationary engineer's certificate.

ENTRY INTO THE INDUSTRY

Officers of the National Employment Service work with officials of local Apprenticeship Boards and school placement officers in helping young persons arrange apprenticeship training with employers. Trade unions are also interested in assisting young men to enter the building trades.

ADVANCEMENT

In the building trades advancement is from apprentice to journeyman; journeyman to foreman, and foreman to superintendent. It must be remembered, however, that opportunities at the upper levels are less plentiful and call for long experience and organizing ability.

There is the opportunity for qualified journeymen to establish their own sub-contracting business and eventually become contractors.

Still others, who have the necessary skill and knowledge, may specialize in the installation of more complex equipment.

Apprenticeship training provides the general background in construction necessary to take advantage of the opportunities to progress to supervisory positions or to establish one's own business. Many men now occupying executive positions in the industry or running their own business began their careers as apprentices in one of the many trades.

WORKING CONDITIONS

Earnings

> *The following tables present the latest available figures on wage rates for various construction trades. Wage rates change frequently. To keep this information current, the reader should refer to local employers, union officials, newspaper employment ads, and government publications such as* Wage Rates and Hours of Labour in Canada, *Department of Labour, Ottawa, and the monthly report on* Employment and Payrolls, *Dominion Bureau of Statistics, Ottawa.*

Hourly rates in themselves present only part of the earnings picture. Number of hours worked per week and particularly number of weeks worked per year are other important factors. Seasonal unemployment, a factor which will affect earnings, is given general treatment on page 35. Some building trades are affected less than others in the winter months; examples of these are plumbers and electricians.

Construction workers are among the better paid of the skilled and semi-skilled workers. A recent survey* showed that the average weekly wages and salaries in construction stood at $67.49, compared with $64.56 for all industries.

Wage rates vary considerably from place to place. Generally speaking, they are higher in larger than in smaller centres. The following tables show prevailing rates in various localities for selected building trades. Wage agreements completed for the first half of 1956 have provided increases of about ten cents per hour over the 1955 figures.

*D.B.S. *Employment and Payrolls,* July 1956.

WAGE RATES AND HOURS OF LABOUR IN CONSTRUCTION (Building and Structures Only)
October 1955(1)

Locality	Standard Hours per Week[2]	Wage Rate per Hour								
		Brick-layer and Stone-Mason	Car-penter	Elec-trician	Painter	Plasterer	Plumber	Sheet Metal Worker	Truck Driver	La-bourer
		$	$	$	$	$	$	$	$	$
Newfoundland—										
St. John's	40-54	1.75	1.40	1.70	1.30	1.55	1.68	1.40	1.15	1.10
Prince Edward Island—										
Charlottetown	.....	1.50	1.05	1.10	.95	1.50	1.10	1.00	.80	.75
Nova Scotia—										
Halifax	40*	1.94	1.69	1.79	1.45	1.83	1.78	1.55	1.23	1.18
Sydney	40	2.20	1.95	1.55	1.35	2.10	1.85	1.50	1.15	1.10
New Brunswick—										
Fredericton	40-44	1.75	1.55	1.40	1.10	1.75	1.60	1.45	.95	.90
Moncton	40-44	1.80	1.50	1.55	1.10	1.80	1.50	1.35	.95	.90
Saint John	40	1.85	1.55	1.60	1.40	1.85	1.60	1.30	.95	.90
Quebec—										
Chicoutimi	48	1.50	1.40	1.40	1.30	1.50	1.35	1.30	1.20	1.15
Drummondville	48	1.60	1.35	1.35	1.25	1.60	1.35	1.35	1.05	1.00
Hull	44*	2.00	1.82	1.95	1.50	1.95	1.85	1.40	1.10	1.10
Montreal	40*	2.10	1.90	2.00	1.80	2.12	2.12	1.90	1.30	1.30
Quebec	44*	1.80	1.60	1.60	1.50	1.80	1.60	1.60	1.20	1.20
St. Hyacinthe	44*	1.55	1.35	1.35	1.25	1.55	1.35	1.35	1.00	1.00
Sherbrooke	40-44	1.65	1.45	1.40	1.35	1.65	1.65	1.65	1.05	1.05
Thetford Mines	44*	1.80	1.60	1.60	1.50	1.80	1.60	1.60	1.20	1.20
Trois-Rivieres	44-48	1.70	1.50	1.50	1.40	1.70	1.45	1.45	1.25	1.15

Ontario—										
Belleville	40	2.00	1.85	1.50	1.25	1.90	1.80	1.80	1.05	1.00
Brantford	40-44	2.35	1.85	1.80	1.45	2.00	1.90	1.45	1.15	1.10
Fort William	40	2.20	2.05	2.10	1.75	2.20	2.05	2.06	1.20	1.15
Guelph	40	2.05	1.70	1.75	1.25	1.80	2.00	1.35	1.15	1.10
Hamilton	40*	2.35	2.15	2.35	1.75	2.25	2.30	2.30	1.20	1.15
Kingston	40	2.15	1.95	1.85	1.50	2.15	1.95	1.65	1.10	1.05
Kitchener	40-45	2.10	1.80	2.00	1.35	2.10	2.10	1.70	1.25	1.20
London	40*	2.25	2.05	2.15	1.47½	2.25	2.20	2.00	1.25	1.25
Ottawa	40	2.10	1.82	2.07	1.50	1.95	2.15	2.02	1.05	1.00
Peterborough	40	2.25	1.65	1.85	1.35	1.75	1.65	1.60	1.10	1.05
Port Arthur	40	2.20	2.05	2.10	1.75	2.20	2.05	2.06	1.20	1.15
St. Catharines	40	2.20	2.05	2.00	1.60	2.00	2.10	2.00	1.20	1.15
Sarnia	40	2.40	2.10	2.30	1.78	2.40	2.30	2.20	1.58	1.50
Sault Ste. Marie	40-44	2.37	2.00	1.80	1.65	2.10	2.05	1.65	1.30	1.25
Sudbury	40-44	2.20	2.00	1.80	1.40	2.00	2.05	2.05	1.20	1.15
Toronto	40*	2.46	2.30	2.50	2.05	2.40	2.35	2.35	1.30	1.30
Windsor	40*	2.45	2.22	2.35	1.80	2.10	2.35	2.25	1.66	1.66
Manitoba—										
Brandon	44	1.95	1.80	1.75	1.60	1.95	1.60	1.45	1.20	1.00
Winnipeg	40-42½	2.25	2.10	2.10	1.75	2.25	2.15	1.82½	1.25	1.10
Saskatchewan—										
Moose Jaw	40-44	2.18	1.95	1.85	1.65	2.00	2.05	1.82	1.15	1.10
Prince Albert	40	2.25	1.75	1.90	1.30	1.90	1.90	1.85	1.15	1.10
Regina	40-44*	2.18	1.95	2.06	1.70	2.20	2.10	1.85	1.25	1.21
Saskatoon	40-44	2.23	1.90	2.00	1.70	2.20	2.10	1.80	1.38	1.33
Alberta—										
Calgary	40*	2.30	2.00	2.15	1.80	2.15	2.20	2.05	1.40	1.35
Edmonton	40*	2.30	2.00	2.25	1.65	2.22½	2.25	2.15	1.40	1.35
Medicine Hat	40	2.10	1.80	1.80	1.35	2.00	1.75	1.50	1.10	1.00
Lethbridge	40-44	2.15	1.80	1.95	1.50	2.00	2.00	1.90	1.10	1.00
British Columbia—										
Prince Rupert	40	2.00	2.25	2.28	2.00	2.00	2.25	2.10	1.55	1.50
Vancouver	40	2.40	2.22	2.42	2.16	2.35	2.35	2.35	1.60	1.63
Victoria	40	2.30	2.25	2.35	2.05	2.30	2.30	2.28	1.70	1.65

(1) Department of Labour, *Wage Rates and Hours of Labour in Canada*, October 1955.
(2) Generally, longer hours than those shown are worked by Truck Drivers and/or Labourers; known cases are indicated by asterisk.

HOURLY WAGE RATES IN CONSTRUCTION FOR SELECTED OCCUPATIONS, BY LOCALITY, 1955.

	Halifax, Dartmouth, N.S. and Zone	Saint John, N.B. and Zone	St. John's, Nfld.	Montreal, P.Q. and Zone	Toronto, Ont.	Winnipeg, Man. and Zone	Regina, Sask. and Zone	Edmonton, Alta. and Zone	Vancouver, B.C. and Zone
	$	$	$	$	$	$	$	$	$
Cement finishers......	1.28	1.25	1.20	1.70	1.97	1.40	1.35	1.70	2.22
Concrete mixer operators.........	1.33	1.00	1.15	1.60	1.50	1.25	1.30	1.45	1.82
Rodmen (reinforcing).	1.33	.95	1.15	1.60	1.50	1.30	1.25	1.65	2.08
Marble setters.......	1.94	1.55	1.55	2.10	2.30	1.90	2.15	2.22	2.40
Terrazzo layers.......	1.80	1.55	1.25	2.10	2.16	1.80	1.95	2.22	2.12
Tile setters (hard).....	1.94	1.55	1.55	2.10	2.16	1.90	2.15	2.22	2.35
Compressor operators	1.33	1.00	1.15	1.60	1.85	1.25	1.30	1.40	1.82
Hoist operators(tower)	1.33	1.00	1.15	1.40	2.00	1.25	1.30	1.40	2.15
Operators (dragline, crane, shovel)......	1.55	1.45	1.50	1.99	2.25	1.65	1.50	1.75	2.45
Drill runners........	1.28	1.00	1.15	1.35	1.35	1.25	1.30	1.40	1.80
Tractor operators (large)...........	1.35	1.25	1.30	1.73	1.70	1.50	1.40	1.50	2.28
Road grader operators.	1.33	1.05	1.15	1.73	1.50	1.30	1.30	1.50	2.28
Structural steel erectors	1.90	1.90	1.60	1.90	2.25	2.10	1.50	2.25	2.46½
Welders and burners (steel erection).....	1.90	1.90	1.60	1.90	2.25	2.10	1.50	2.25	2.46½
Welders and burners (acetylene or electric)	1.55	1.30	1.45	1.80	1.75	1.35	1.38	1.65	1.75
Elevator constructors..	1.89	1.89	1.89	2.31	2.39	2.09	2.09	2.25	2.36
Asbestos insulation workers..........	1.48	1.30	1.30	2.05	2.25	—	1.45	2.00	2.20
Lathers (wood, wire, metal)...........	1.55	1.05	1.15	2.10	2.40	2.00	1.95	2.00	2.37½
Roofers (built-up)....	1.28	1.05	1.15	1.70	2.00	1.25	1.25	1.50	1.85
Divers.............	2.25	2.25	2.25	2.75	3.00	2.65	2.65	2.65	3.00
Sprinkler installers....	1.70	1.70	1.70	2.05	2.25	2.05	2.05	2.10	2.25

Source: Figures derived from minimum wage schedules established under Fair Wages and Hours of Labour legislation.

Labour Organization

The long association of the traditional building trades with the guild system in Europe led to the early establishment of labour unions in the construction industry, usually along craft lines. Today, local construction employees' groups mainly operate under charters received from international unions affiliated with the newly formed Canadian Labour Congress, although independent unions have jurisdiction in some localities.

In the Province of Quebec and some bordering areas of the Provinces of New Brunswick and Ontario, many construction workers are organized under local "syndicates" which represent the various trades and are affiliated with the Canadian and Catholic Confederation of Labour.

Seasonality

The problem of seasonal unemployment in construction is less serious than it was years ago. In the 1920's and 1930's, the number employed in the slack winter months was often less than one-half the number employed during the peak summer and fall months; in the years 1953-55 it was about two-thirds. Positive steps have been taken by the construction industry in the last two years to develop a co-ordinated campaign to increase the volume of winter construction, and in this respect, federal, provincial and municipal governments are planning public works projects with a view to minimizing the winter decline in construction.

Hazards

Construction work is not without certain risks of injury. Principal hazards are falls from heights, contact with electric currents, over-exertion resulting in strains, and from fire, extreme temperatures and explosions. Falls and slips from scaffolds, stagings and roofs constitute the greatest cause of serious accidents in this industry.

The industry has become safety conscious, and, within the limits imposed by the nature of the work, has encouraged the regular inspection of scaffolds, stagings, hoists and other construction equipment, in order to increase the safety factor.

Much depends on the common sense of the individual worker to observe safe working habits for the protection of himself and his fellow workers.

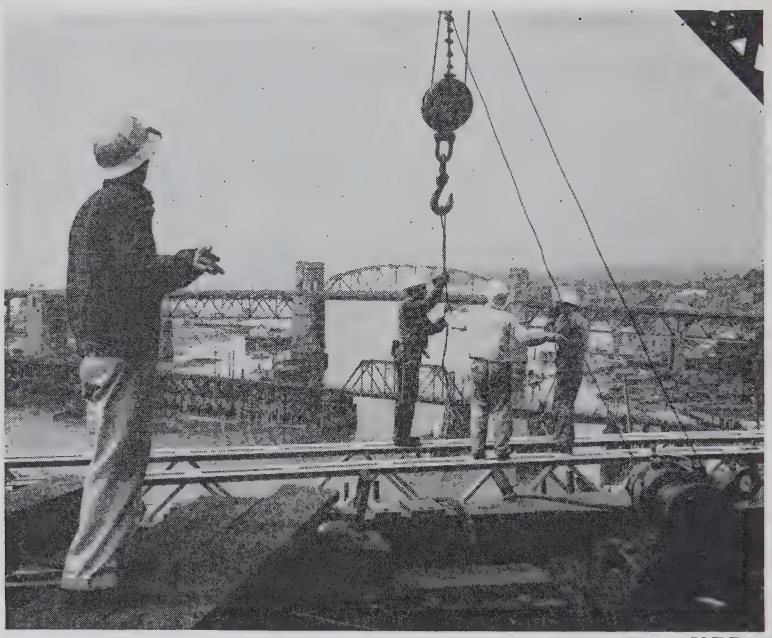

Photo: N.F.B.

Spanning broad rivers with bridges of steel.

ADVANTAGES AND DISADVANTAGES

The construction industry offers a choice of varied and satisfying careers in the building crafts, in professional and technical jobs, and in business. There is opportunity for development and improvement in skill, and the prestige that comes with belonging to a recognized and respected group of workers who are making an important contribution to the national economy. This is particularly true of workers in the "building trades", whose skill has been achieved over a period of years and improves with experience.

Construction workers also have tangible evidence of the work they have done as the buildings, roads, dams and other projects take shape under their hands.

Employment opportunities exist in all parts of the country, with prospects for advancement, including a good opportunity to establish an independent business on a relatively small capital investment. The building trades are particularly favoured in this respect, and the 1951 census shows that 20 to 24 per cent of the bricklayers and stonemasons, painters and plasterers were employers or self-employed, as were 16 per cent of the carpenters, 13 per cent of the plumbers and 10 per cent of the electricians.

Working time lost through seasonal conditions, changing from job to job, or from bad weather, is a disadvantage. However, wage rates are relatively high to compensate for loss of time, and all construction workers are covered by Unemployment Insurance benefits and Workmen's Compensation.

The place of employment will change as projects are completed and new ones start, and it may be necessary to travel some distance to and from work. Since construction is carried out in all areas, it is possible to move about the country and stay within one's trade.

Vacations with pay have been introduced in most localities. A percentage of the worker's pay (usually 2 to 4 per cent) is paid by the employer in the form of stamps which may be cashed in for holiday pay, or the worker may receive extra pay in lieu of holidays.

FUTURE PROSPECTS FOR THE INDUSTRY

As in the past, construction activity will remain closely linked with the general economy, and both the short-term and long-term prospects are bright. Based on the present rate of expansion, it is estimated that the construction program will amount to between $14 and $15 billion by 1980. The backlog of requirements for houses, schools and universities, hospitals, roads, and power developments, and the fact that many of our structures are due for replacement because of age or obsolescence are additional reasons for anticipating increased future construction programs.

The development of new building techniques, new materials and increased mechanization will increase production and may change the skill content of some jobs. It is not likely, however, that any of the basic building trades will become obsolete, and well-trained tradesmen will continue to adapt to new techniques and materials.

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LOCAL INFORMATION

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 12, 13 and 39, have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
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(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

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DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

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by the

Economics and Research Branch

of the

Department of Labour, Canada

HON. ALLAN J. MacEACHEN
MINISTER

GEORGE V. HAYTHORNE
DEPUTY MINISTER

First Edition 1957

Second Edition 1964

Note . . .

Information previously issued in separate booklets has been revised and included in this publication. The following titles have therefore been discontinued:

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1964

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada and from other quarters.

THE CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Technical and Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This booklet was prepared and written for the Manpower Resources Division by Alvin E. Styles and William Coe under the direction of William Allison, Head of the Occupational Analysis Section.

The branch is greatly indebted to the many organizations and companies whose assistance made this monograph possible.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

June 1964

CONTENTS

CONTENTS—continued

CAREERS IN CONSTRUCTION

HISTORY AND IMPORTANCE

It is impossible to envisage our present way of life without considering the works of the builders, both past and present. The structures and engineering projects which represent our progress and prosperity are constant reminders of the importance of the construction industry in our daily lives. Spacious apartments, comfortable homes and handsome public buildings provide amenities for modern living; highways, railways and harbours facilitate the rapid transit of goods across the country; and dams regulate our rivers to provide electrical power to our homes and industries.

In Canada's first historical period, construction projects were limited to fortifications and habitations for the military. Some 350 years ago, Champlain and his associates built Port Royal, "a beautiful settlement in a great quadrangle of spacious homes built of fragrant logs". A year later a graded road—the first of many—connected this settlement to Digby Cape. This marked, if not the first, at least the beginnings of our present-day construction industry.

During the 17th and 18th centuries, settlers moved up the St. Lawrence and Ottawa Rivers and their tributaries and an uncertain start was made in the construction of dwellings and works of public utility. As can be expected in a forested country, these were primarily of wood which was cut and erected either by the settlers themselves or, where the construction was complicated, by carpenters. Soon, more permanent types of building material were to be used. Stone quarries, brick-and-tile plants and lime kilns were opened up around Trois Rivieres and stonemasons, bricklayers and other craftsmen became active. Sheet-metal workers also, using imported metal called "fer blanc" were busy on the silver-coloured roofs so typical of Old Quebec.

With the turn of the 19th century, it became obvious that means of transportation had to be provided if the country was to grow, and attention was focussed on such works as canals, roads, docks and harbours. In spite of the rugged mountains and broad rivers which had to be crossed, and the extremes of cold and isolation, the Great Lakes-Rideau Canal was built in 1826; the first iron bridge—the Victoria Bridge—spanned the St. Lawrence River in 1854; and the railroads were extended from coast to coast.

The industry was soon to turn to other materials and processes thus increasing the specialization within the industry and giving rise to new crafts. For example, the inventions of Bessemer and Siemens which considerably reduced the cost of mild steel, and the discovery of cement first used in 1825, led to the use of structural steel and reinforced concrete. Highways, roads, bridges, canals and other public utilities were taken over by "engineering construction" workers, a new group headed by civil engineers. These men applied mechanical construction techniques which had previously been the task of the military. To these developments were added such discoveries as perfection of the steam engine by James Watt which opened up the way for power equipment and power-equipment operators.

These are but a few of the many changes which have taken place since Champlain built his early settlement "of fragrant logs". New materials and new forms of old materials are continually being added; equipment such as heating and lighting installations are being improved and their range extended; buildings and engineering projects are larger and, in consequence, are much more complicated; and prefabrication—where many parts are delivered to the building site in a finished condition—is becoming a common practice.

Since World War II, the construction industry has seen phenomenal growth: in the past decade, the St. Lawrence Seaway has enabled ocean-going vessels to reach the Lakehead; the Trans-Canada Highway now extends from coast to coast. Work is under way on such engineering construction as the South Saskatchewan dams from Squaw Rapids to Qu'Appelle, the Winnipeg Floodway and the Peace River power project in North-eastern

British Columbia. New building construction is changing the skyline of many major cities while attention is being given to churches, houses, schools, hospitals, apartments and the many other buildings required by an ever-increasing population.

As a result of these changes, the term "construction" is now used to cover many different branches of the industry. This booklet is designed to provide information on workers in two broad divisions—building construction and engineering construction—and also includes those employed by companies specializing in plumbing, painting and decorating, plastering, roofing, sheet-metal work, or in the installation of air-conditioning, electrical and similar equipment.

FIELDS OF WORK

Employment in the construction industry will be found in every community across the country. Of the approximately 600,000 workers in the industry, about three-quarters are employed in firms whose only business is that of construction; the remaining quarter are with government agencies, public utility companies and as maintenance personnel in manufacturing establishments.

There is a significant difference between fields of work in the construction industry and, say, a manufacturing industry. Employees in manufacturing and similar enterprises have a fixed place of employment—the factory, plant or mill where their product is made. In contrast, construction workers, particularly craftsmen and their helpers, have no permanent work location; when construction is finished on one site they are then required to move to the next and may often have to change employers. The distance between construction sites will depend on the type of construction in which the worker is engaged, and the size and nature of the employer's business.

The work undertaken by the construction industry varies considerably for, in addition to new construction projects, there are vast numbers of repair, maintenance and reconditioning jobs.

The organization of the firms which have evolved to do these jobs shows a corresponding variety. For ease of understanding, construction work will be explained in the divisions previously mentioned—engineering construction and building construction—although it must be pointed out that some firms usually called "heavy construction" firms, undertake both engineering and building.

Engineering construction may be defined as work involving highways, streets, railroads, airports, bridges, tunnels and subways; pipelines, power and communications systems; dams, docks, harbours, piers, elevators, and similar marine works; and reservoirs, canals, dams, sanitary systems and other waterworks. Engineering construction firms usually undertake large-scale projects and their operations extend across a province and often into adjacent regions; a few operate across the country and even abroad. Although these firms recruit much of their labour locally as the need arises, they maintain their own work force of supervisory, technical and skilled personnel. The work force is required to travel and live considerable distances from their home base, perhaps in a trailer camp at the construction site. Since most of these projects are large, workers can expect one or more years of employment before moving to another major construction job.

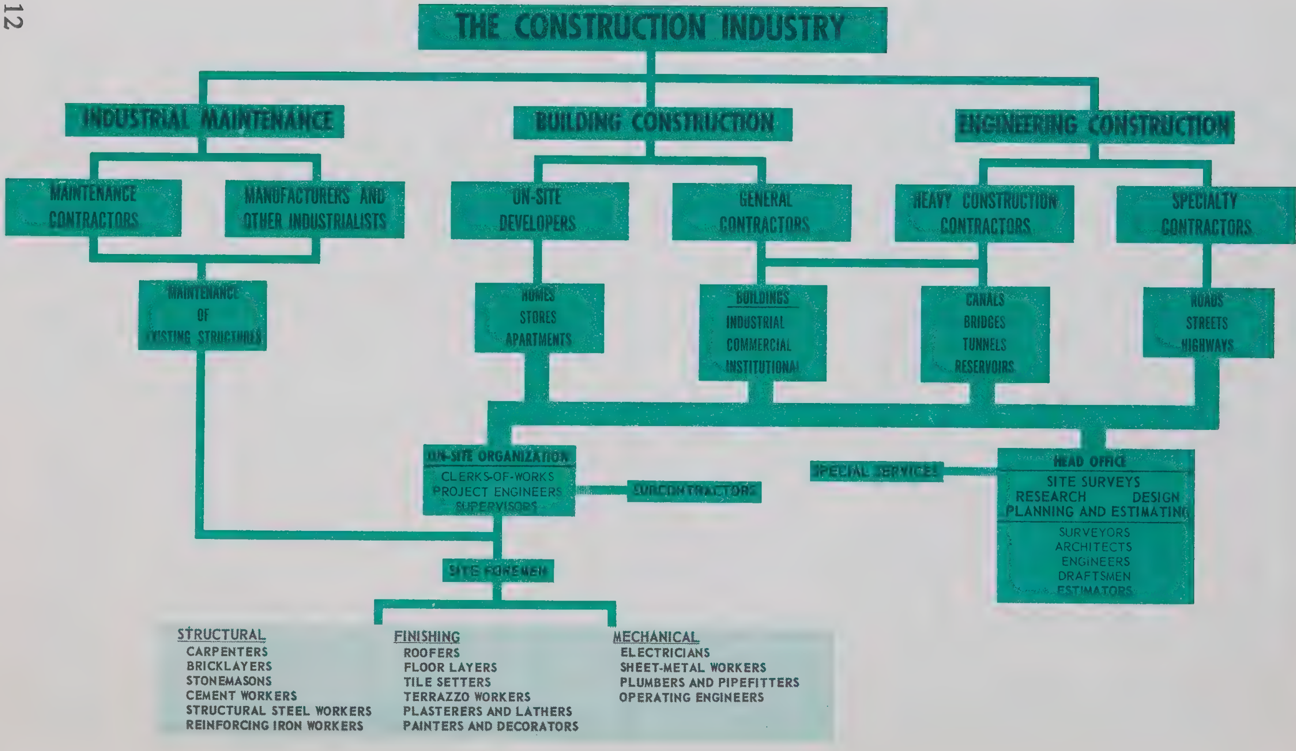
Building construction comprises several different kinds of enterprise: these include general contractors who undertake and coordinate the construction, maintenance and repair of industrial, commercial, institutional (hospitals, etc.) and similar large-scale buildings; on-site developers who build housing projects, stores, apartments (of limited size) and other residential accommodation on a speculative basis with a view to selling the final product after the work has been initiated; or specialty firms in such work as industrial maintenance. In addition, there are subcontractors who specialize in any of the following: bricklaying; lathing, plastering and stucco work; painting, decorating and glazing; plumbing, heating and air-conditioning; electrical work; roofing; sheet-metal work; floor finishing; or tiling.

Large-scale general contractors and on-site developers usually have their own work crews although a growing proportion of the

work is being subcontracted. For their functions they maintain a staff of estimators, site superintendents, foremen and some key workers. While an effort is made to retain these workers as part of the employer's permanent labour force, the ability to do so depends to a large extent on the volume of work on hand. Owing to certain factors, such as travelling expenses for example, the area of operations tends to be local in nature and is often confined to a radius of 50 to 100 miles although larger firms operate much further afield.

Subcontractors provide labour and services to general contractors in one or more specialties. They are usually smaller than general contracting firms and frequently move within a small radius but may travel further afield when work cannot be obtained in their own area.

In addition to these main fields of work, there are those in other than construction companies. These include the following employment areas: with local authorities who construct and maintain streets, water supplies and other public utilities; establishments engaged in gas, electrical and other transmission systems; railway companies who construct, maintain and repair their own rights-of-way; industrial companies and the government agencies who, in addition to architects, engineers and other technical staff, have a work force of bricklayers, painters, carpenters and other craftsmen on their payroll. As will be realized, these workers in contrast with those employed by construction companies, have a more permanent workplace and are often employed on a year-round basis.


THE CONSTRUCTION INDUSTRY
INDUSTRIAL MAINTENANCE
BUILDING CONSTRUCTION
ENGINEERING CONSTRUCTION
MAINTENANCE CONTRACTORS
MANUFACTURERS AND OTHER INDUSTRIALISTS
ON-SITE DEVELOPERS
GENERAL CONTRACTORS
HEAVY CONSTRUCTION CONTRACTORS
SPECIALTY CONTRACTORS
MAINTENANCE OF EXISTING STRUCTURES
HOMES STORES APARTMENTS
BUILDINGS INDUSTRIAL COMMERCIAL INSTITUTIONAL
CANALS BRIDGES TUNNELS RESERVOIRS
ROADS STREETS HIGHWAYS
ON-SITE ORGANIZATION
CLERKS-OF-WORKS
PROJECT ENGINEERS
SUPERVISORS
SUBCONTRACTORS
SPECIAL SERVICES
HEAD OFFICE
SITE SURVEYS
RESEARCH DESIGN
PLANNING AND ESTIMATING
SURVEYORS
ARCHITECTS
ENGINEERS
DRAFTSMEN
ESTIMATORS
SITE FOREMEN
STRUCTURAL
CARPENTERS
BRICKLAYERS
STONEMASONS
CEMENT WORKERS
STRUCTURAL STEEL WORKERS
REINFORCING IRON WORKERS
FINISHING
ROOFERS
FLOOR LAYERS
TILE SETTERS
TERRAZZO WORKERS
PLASTERERS AND LATHERS
PAINTERS AND DECORATORS
MECHANICAL
ELECTRICIANS
SHEET-METAL WORKERS
PLUMBERS AND PIPEFITTERS
OPERATING ENGINEERS

NATURE OF WORK

It is the function of the construction industry to fill a need with a material shape. Thus, a need for accommodation materializes in the shape of houses and apartments; for more utilities in the form of a reservoir, a dam or a generating station; for public amenities as a school, hospital or civic centre; or a need for transportation facilities as a highway, bridge or tunnel. This wide variety of projects demands an equally wide variety of skills and in many different though related occupations.

INITIATION OF WORK

The general contractor may act as developer, especially in the residential building field, and thus both initiates and executes the work. However, most construction projects are initiated either by a buyer or an owner. In the case of highways, roads and bridges, the developer may be a municipal or provincial authority; public utility companies may initiate a new generating station; or an industrial company a new factory. On-site developers purchase land for the development of a housing site, a shopping centre or an apartment building.

PLANNING

In the planning of any construction project, the first step is usually known as a "feasibility study". Depending on the kind of project, this may be done under the direction of the architect or the civil engineer or both; their duty is to report on the suitability of the site, whether the project can be done and how best it can be accomplished.

To complete the study, information is obtained by other specialists; when considering the route of a proposed new highway, for example, information is required on geological formations and surface contours. If a tunnel is to be built or land excavated, boring crews will drill and provide samples of the strata to *soil*

mechanics engineers. Their findings will determine whether the route is suitable and the kind of foundation required for the bridges and overpasses.

A new power station, a reservoir or a dam will involve a study of several alternative sites; natural features may have to be charted by *land surveyors* who must also consider land elevations and the boundaries concerned with land ownership. The type of structure to be built—whether a bridge shall be cantilever, suspension or supported on piers—and the materials to be used, will involve other personnel such as mechanical and hydraulic engineers, metallurgists and their assistants.

If the results of the study prove satisfactory, preliminary drawings and estimates of the cost of the structure are made for submission to the owner and to various authorities for approval under municipal, provincial and federal building regulations. Depending on the kind of structure, these drawings may be prepared under the direction of an architect or an engineer or they may collaborate—the architect taking responsibility for general design and aesthetic aspects and the engineer being concerned with strength, stability and other structural features. There are certain obvious exceptions such as the construction of a reservoir or dam where architectural work is not normally required. In addition, the services of other consultants such as mining, hydraulic and sanitary engineers, and the designers of electrical, air-conditioning and similar installations may be required.

When the preliminary plans have been approved by the owner, design plans and the detailed drawings and specifications to be used on the actual construction site are prepared. These data are then made available to general contractors who are invited to tender prices for the work of construction and to other contractors who may reply to advertisements.

CONTRACTING

The major burden at the tendering stage falls on the general contractor's *estimators* who calculate amounts and costs of materials, labour and services. This is the stage at which the

general contractor usually invites subcontractors to quote for their specialty, e.g., a steel-fabricating company may be invited to tender for the construction and possible erection of steelwork, or an electrical subcontractor may be invited to tender for lighting and electrical power installations.

ON-SITE CONSTRUCTION

The successful contractor opens up the job with a *project superintendent,* a *general foreman* who is the link between the superintendent and section foreman, key personnel who do the job of surveying and laying out within the confines of the actual construction site, and other skilled workers. Also appointed to the larger construction sites is a *resident engineer* who checks the progress and execution of the work on behalf of the civil engineer, or a *clerk-of-works* who performs similar duties for the architect.

Site Preparation

Temporary roads, water and power supplies together with accommodation for workers and materials may first be required. Trees, undergrowth and rocks are removed by *bulldozer operators* and, where necessary, existing structures are demolished by wreckers often assisted by *crane operators* who swing heavy weights to shatter the structures. Within the legal boundaries established by land surveyors, elevations and levelling points are determined by engineers or other technical staff and, as necessary, the site is excavated by *shovel operators* and levelled by *grader operators*.

Some excavations are made to form an actual part of the project such as canals and tunnels. Other excavations are often made for the foundations of a building until ground sufficiently strong to bear the load of the structure is reached. These excavations and the later grading and levelling are done by skilled operators of heavy earth-moving equipment which ranges from small bulldozers to giant draglines, scrapers and graders. Handling of material at the excavation site, and of other bulk materials,

requires the extensive use of power-driven equipment, hence the employment of many skilled equipment operators and vehicle drivers at construction sites.

Because of the diversity of construction projects, many other types of workers are involved. In excavating, rock may have to be drilled by *pneumatic drill operators* and blasted by *shotfirers* (powdermen). In tunnelling operations, *miners* or skilled helpers lay and fire explosive charges. Engines for pumping water out of an excavation and providing power for other purposes are kept in running order by *pumpmen* or *stationary engineers*. In marine and subway operations, *caisson workers* are employed in chambers pressurized with air from plants controlled by *compressor operators*. If underwater work is necessary, the services of a *diver* may be required; he may be a craftsman or at least can lay stone and concrete blocks and use pneumatic and welding tools.

Highway construction consists mainly of excavating and grading carried out by operators of earth-moving, levelling and transport equipment; paving is done by *concrete workers, asphalt tampers, smoothers* and *spreaders,* and *paving-machine operators.*

Foundations

When excavating is completed, foundations which carry the weight of the structure are laid. If the ground is soft, pilings of steel, concrete or wood are driven into the ground to support the foundation. This is the work of a crew of pile drivers who set the machine in position and remove it when driving is completed.

Concrete is used extensively for foundations and is also used for retaining walls, floors and support columns. Forms which give the concrete the required shape and provide support while it hardens may be made of wood and installed by *form carpenters* who also install chutes through which the concrete is poured. Metal forms are also used and, in this case, installation is by *form setters.* Some concrete structures are reinforced or strengthened with steel rods which are secured within the forms by *reinforcing iron workers* (rodmen).

As a rule, concrete ready for pouring is delivered to the construction site by commercial suppliers. On some projects, particularly road building, owing to the distance from ready-mixed suppliers, the concrete is mixed with aggregate at the construction site by *mixing* and *batching plant operators*. From the mixing plant, concrete may be delivered by truck or piped under pressure to where it is required. It may be poured into chutes leading to the forms or forced into the forms by *concrete-gun operators*. Other workers such as *vibrator operators* tamp the concrete to remove air spaces and *concrete finishers* may level the surfaces.

Framing

This and the following stages of construction are limited mainly to building projects and do not ordinarily enter into engineering projects such as dams and canals. Construction of steel bridges and transmission towers does, however, include a stage similar to structural steel rigging which is outlined below.

The term framing is generally applied to the work of *frame carpenters* in connection with residential and light wood construction. These carpenters lay wooden sills on the foundation, on which the floor joists rest; lay subflooring; erect the studs for siding and walls; and complete the roof frame.

Framing for large buildings calls for engineering skill and the specialized knowledge of many different workers. The materials used must be able to carry tremendous loads. Structural steel, reinforced concrete, or combinations of both, and more recently, reinforced concrete precast into beams and girders, are common framing materials.

In steel framing, girders, rafters, trusses, braces and other steel members are fabricated according to specifications in a steel-fabricating plant, and are brought to the construction site where they are unloaded and hoisted into position by *cranemen*. *Structural steel workers* bolt them temporarily into place and align them, after which they are welded securely by *welders*, or riveted together by *riveters*.

In reinforced concrete framing, the upright columns, floor girders and beams, and the roof supports, are made of reinforced concrete poured into forms or moulds and allowed to harden. Floors and roof slabs may also be formed in this way. Form carpenters build the plywood forms, steel reinforcing bars are bent and positioned by iron workers, and concrete is poured into forms and allowed to harden.

Exterior Finishing and Roofing

Exteriors of modern buildings serve primarily as a protection against the elements and for ornamental effect, rather than as in the past as strong, weight-bearing walls. This allows for a wide selection of materials to finish the frame. The materials used will determine whether *carpenters, bricklayers, stonemasons, sheet-metal workers* or *plasterers* or a combination of these craftsmen apply them.

When the exterior walls are completed and the openings framed, sashes of metal or wood are installed. *Caulkers* weatherproof the joints with sealing compounds. Cutting the glass and mounting it in the framework is the job of glazing crews which include *glaziers* and *metal mechanics*. For example, window sashes may be supplied already glazed, otherwise the glazier must cut and fit the sheets of glass; plate glass such as is used in store fronts, doors and similar openings may be mounted in metal channels by the metal mechanics; or, where the glass is not framed, such as in a theatre door, it must be cut by the glazier to accommodate handles, hinges and similar hardware.

On completion of the roof framing, carpenters lay wood sheathing on the framework. *Roofers* nail on overlapping shingles of asphalt composition, wood, slate, tile or terra cotta.

Electric Wiring and Plumbing

Before the interior walls are completed, *electricians* position electrical conduits, outlets and switches, according to drawings, and complete the wiring to fuseboxes and panels. Fixtures are installed after the interior walls are finished.

Arrangements for water supply, drainage and plumbing fixtures are specified by blueprint. *Plumbers* cut, thread and install various pipes and valves, make connections with water mains and sewers, and install some of the fixtures. When the interior walls are finished, the plumbing installation is completed.

Special Installations

Modern building requirements go beyond standard electrical and plumbing facilities. Automatic heat controls, refrigeration or air-conditioning equipment, involving multiple thermostat controls, mechanical and electronic switching and cut-out panels are installed and brought into operation by *air-conditioning* and *refrigeration mechanics, pipefitters, electrical technicians* and other highly skilled craftsmen.

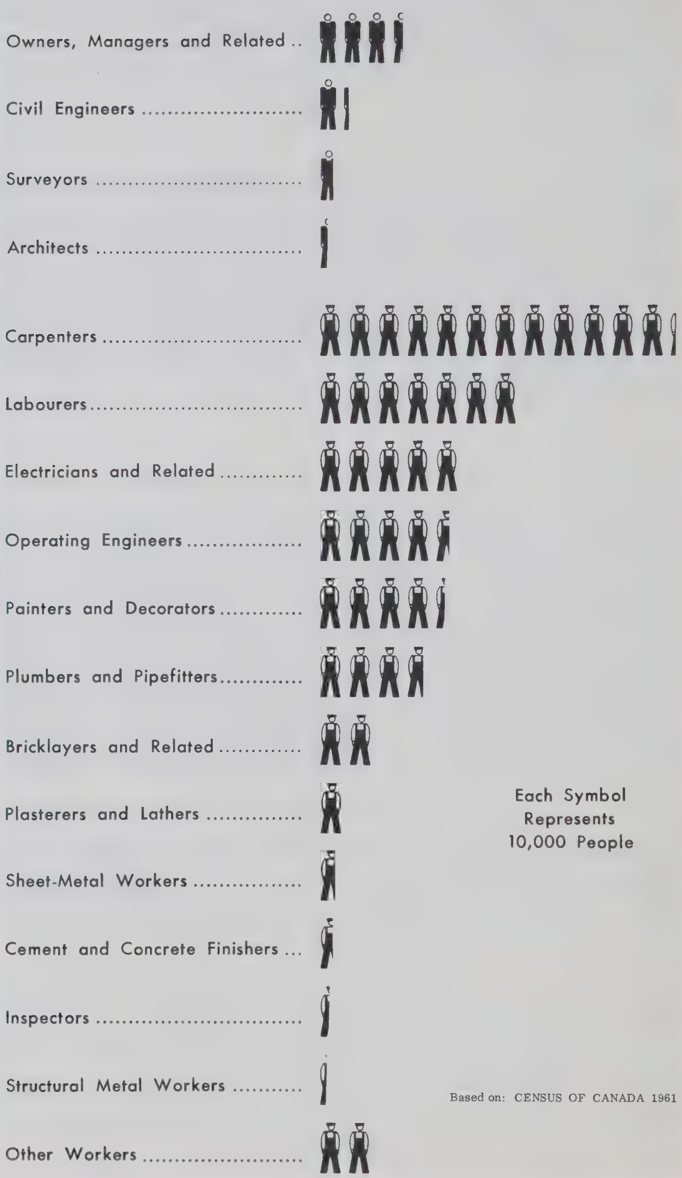
Interior Finishing

The traditional interior wall finish has been of plaster. Developments in "dry wall" or composition or plasterboard and of wood panelling have made available many new and different finishes. Wood lath, once commonly used as a base on which to apply plaster, has given way to metal lath and plaster board. *Lathers* nail or staple plasterboard or metal lath which forms the base for the plaster. *Plasterers* prepare all surfaces and then apply several coats of plaster in plain or decorative patterns to the walls.

Floors may be covered by carpenters who specialize in laying floors of wood, nailing it to the subfloor boards, sand the newly-laid floor and apply protective coatings of sealer and wax. Other materials such as tile, terrazzo, asphalt, concrete and even brick are laid by *tile setters* and *concrete finishers.*

Finish carpenters skilled in fine work, complete the details of wood as stairs, mouldings, cupboards, panelling, doors and windows.

DISTRIBUTION OF WORKERS



Based on: CENSUS OF CANADA 1961

Final work to the building is done by *painters* and *decorators* who apply paints and varnishes or wallpaper according to prearranged specifications and colour schemes. *Ornamental iron workers* may add decorative iron supports or railings, columns, stairs and gates.

Some large buildings require additional fixtures such as elevators, escalators, water tanks, sprinkler systems and refrigerated storage rooms and these are usually installed by the manufacturer's specialist craftsmen.

WORKERS IN THE INDUSTRY

Occupations in the construction industry may be considered in two different though related groups: (1) design and technical staff and (2) construction workers employed at the actual building site. There are several important reasons for this division: primarily, there is a marked difference in methods of training and working conditions.

Design and technical functions are undertaken by teams of specialists under the direction of architects and civil engineers. These functions require an extensive knowledge of mathematics, sciences and similar subjects which are normally obtained through courses given in universities and institutes of technology, both of which require high school graduation on entry. In contrast, on-site construction work primarily requires skills with the hands and is undertaken by craftsmen and related workers. Their training is a combination of working experience and trade school education for which entry requirements are somewhat lower. Working conditions vary also and range from air-conditioned design and technical offices to the construction sites where the craftsmen are exposed to extremes of weather.

DESIGN AND TECHNICAL STAFF

Architects

An *architect* is one who designs schools, churches, office blocks, stores, apartments and similar structures or groups of buildings such as university and housing developments; prepares design and working drawings and specifications; co-ordinates the work of other design consultants; and, finally, supervises the work of construction on behalf of the owner. Architects are also engaged in town and city planning, landscaping (where they may be known as landscape architects), building inspection and appraisal, teaching and research.

Where Employed

Of the approximately 3,000 architects in Canada, 45 per cent are located in the metropolitan areas of Toronto and Montreal; the remainder are located in the larger population centres across

Photo: N.F.B. f/s

Architects develop structural designs which are attractive as well as functional.

the country. A high proportion—about one third—of the architects are self-employed and usually in partnership with other architects maintain their own offices. Others are on the payroll of government agencies, railway companies, architectural and engineering firms, public utility companies and a few of the larger industrial and manufacturing establishments.

Nature of Work

In the design of a project, the architect first consults with the client to determine the purpose of the building, overall objectives, size and possible location, cost range and other desired features. Next the architect makes preliminary sketches showing proposed internal, external and other principal features and estimates probable costs. This information is then submitted to the client who either approves or requests certain design changes.

When final approval has been obtained from the client, the architect is ready to proceed with the next stage—that of preparing working drawings and other data in accordance with building codes and local regulations. These drawings which show plans, elevations, sections and typical details and specify the quantity and quality of materials and workmanship, will be used by the contractor to estimate prices and, later, as instructions to the workers on the construction site. At the same time, drawings and specifications are prepared by civil, mechanical, electrical and other engineers in collaboration with the architect. These drawings include the design of structural steel, reinforced concrete and of electrical, air-conditioning, plumbing and similar installations.

When tenders are received, the architect may help select a general contractor and assist in preparing contract documents which define contract prices, methods of payment, time limitations and other special conditions.

Once the contract has been placed it is usual for the contractor to assume responsibility for all activities on the construction site and for the architect to ensure that the design specifications are being followed. On large projects the architect usually appoints a clerk-of-works as his representative on the site.

The architect acts as co-ordinator of the "technical team" (page 34) and as administrator of the construction project while the general contractor is responsible for co-ordinating and expediting the various building trades.

Preparation and Training

The practice of architecture is regulated by provincial statutes which are administered by the provincial associations of architects. In each province, the association of architects is the statutory body empowered to examine the qualifications of applicants for registration and only those who are duly registered with an association may legally practise architecture. Membership in a provincial association provides automatic membership in the Royal Architectural Institute of Canada, entitling the architect to add M.R.A.I.C. after his name. Requirements for registration vary from province to province but all require high school graduation together with academic training (usually a university degree) and two or more years of practical working experience.

Graduation from an accredited school of architecture is the training method advocated by the architects' associations. Courses of study leading to the degree of Bachelor of Architecture are offered at the following institutions:

> *University of British Columbia, Vancouver, B.C.* — six-year course (three years of liberal arts followed by three years of architecture).
>
> *University of Manitoba, Winnipeg, Man.*—five years.
>
> *McGill University, Montreal, P.Q.*—six years.
>
> *University of Toronto, Toronto, Ont.*—five years.
>
> *Nova Scotia Technical College, Halifax, N.S.* — four years following two years of pre-engineering (university) or equivalent.
>
> *Ecole d'Architecture de Montreal, Montreal, P.Q.*—five years (entrance requirements equivalent to liberal arts degree).
>
> *Ecole d'Architecture de Quebec, P.Q.* — five years (entrance requirements equivalent to liberal arts degree).

The cost of tuition and other charges for these courses ranges from $300 to $700 per year to which must be added the cost of room and board for those living away from home. A period of working experience, varying from six months to a year, is required before the degree is granted and this is usually obtained during summer holidays.

It is possible to become an architect (except in the province of Ontario) by serving a five-year articleship with a registered architect and completing the examinations of the provincial association. Full-time courses of study are provided in provincial institutes of technology in architectural subjects for which an allowance of two years may be given towards the five years of articleship.

A third possibility is to register as a student with a provincial association and, while working in an architect's office, to prepare for the association examinations by evening and correspondence courses. The Royal Architectural Institute of Canada can provide a recommended syllabus of training. Self-study takes a considerable time, probably ten years, and is not generally encouraged.

Personal Qualities

Architecture is the fine art of creating structures of beauty and, for this reason, architects must have a marked interest in the arts and a talent for drawing. They need an original and creative turn of mind, imagination and the power of visualization. To these must be added a practical outlook: decisions as to which methods and materials to use within certain cost limitations demand a practical as well as an artistic frame of mind. Since the architect's success depends not only on ability, but also on personal service, a strong but tactful and pleasant personality is necessary.

Working Conditions

Architects' offices, designed not only as working areas but also for the reception of clients, are clean, well-lighted and usually air-conditioned. Frequent visits to the construction site are, however, required and seasonal weather conditions will be encountered.

Civil Engineers

Design and construction of stationary structures and the surveying and reconstruction of geographic features of the earth are the work of *civil engineers.* These structures include the highways, dams, bridges, railroads, sewers and similar amenities which are essential to modern living.

Where Employed

Civil engineers work in all parts of the country but the largest numbers are located in or near the larger population centres. Others are stationed in the more remote areas of the country particularly when working on projects such as dams and reservoirs required to harness natural resources.

About half of the civil engineers are employed by provincial, federal and local government agencies. The second largest group is in the construction industry. In addition, many are employed in consulting work where they are self-employed while others are in the iron and steel, forestry, logging and wood products industries and in the transportation field.

Photo: N.F.B. 77950

The civil engineer discusses design requirements with the project engineer on the site of a new dam.

Nature of Work

The civil engineering field comprises many different specialties for, down through the years, this field has been dividing and subdividing into separate branches. Following are brief descriptions of the main branches which will indicate the wide variety of work in which the civil engineer may specialize:

Structural engineering—

> the analysis, design and construction of industrial and commercial buildings, bridges, dams, tunnels and similar structures.

Sanitary engineering—

> design, planning and administration services for: the provision of water supplies; disposal of sewage and other wastes; control of water, soil and atmospheric pollution; and the many other problems related to health.

Transportation engineering—

> the planning, design, construction, administration and operation of highways, roads, airports and railroads.

Hydraulic engineering—

> the application of hydrology (science of water), meteorology and fluid mechanics (relation of water to mechanical energy) in the design of structures for flood control, irrigation, harbours, canals, and reservoirs.

Even within these areas there are further specialties such as soil mechanics, traffic engineering and town planning. In any of these branches, however, the work of civil engineering will comprise one or several of the following: research (fundamental and applied); design; production and production planning; administration and supervision; field exploration; consulting; sales and service; and teaching, instructing and extension work. These functions are explained in detail in the booklet CAREERS IN ENGINEERING in this series, to which the reader is referred should further detail be required. In addition, the booklet gives full details on the method of training, personal qualities and other information for those interested in engineering careers.

Preparation and Training

To practise as a civil engineer, it is first necessary to obtain membership in a provincial Professional Engineers' Association, the minimum requirement for which is usually a university degree. In preparation for this degree, the high-school student will be required to matriculate in such courses as algebra, trigonometry, physics and mechanics.

An alternative method is by successfully completing examinations laid down by provincial engineers' associations for which tuition can be obtained by evening or correspondence study. This is an extremely long method, probably taking ten years, and one which is not encouraged by engineers' associations.

Personal Qualities

A high aptitude for mathematics, physics and mechanics is required. The civil engineer must be resourceful and imaginative in working out solutions to the many different problems which are encountered. A willingness to accept responsibility and the capacity to direct other members of the technical team are also required.

Working Conditions

Civil engineers may be "on the move", particularly in the early years of their employment. That is, they work in remote areas and move, probably every year or so, from one construction camp site to the next. Their duties may include a great deal of active work and seasonal weather conditions will be encountered, both of which require reasonably good health and strength. Later in his career, the civil engineer may spend more of his time in administration or in the design office at the headquarters of the business or government; however, others may go directly into the design and administration offices.

Land Surveyors

Surveying is the linear and angular measurement of points, areas, elevations and boundaries on the surface of the earth. This work is undertaken by *land surveyors* who are chiefly concerned with the accurate location of property boundaries or work related to the location, conception, planning or actual execution of construction projects.

Where Employed

A high proportion of the land surveyors are employed by provincial, municipal and federal agencies. Others work for engineering and architectural firms, building contractors and railroad, forestry, mining and public utility companies. A sizeable number of the surveyors registered with provincial associations are listed as being in private practice where, either as individuals or in partnership with other surveyors, they maintain their own professional businesses. Usually the main offices of these organizations are located in large population centres across the country.

Nature of Work

Surveying is undertaken in two areas: (1) in the "field" which may range from surveying the city centre to the isolated site of a new power dam and (2) back in the main headquarters where notes made in the field are analyzed and converted into plans, drawings, maps and other data.

Field surveying is the work of a "field survey party" consisting of from two to seven men under the direction of the surveyor. They are: an *instrument man* (who may be a land surveyor), a *notekeeper* (in some provinces), a *rodman* and two *chainmen* together with axemen and labourers who assist in staking out and clearing brush from the survey line.

The first task of the surveyor is to determine the point from which elevations and distances are to be measured; then, the instrument man sets up and adjusts the theodilite which is used

Photo: N.F.B. 62-4365

Photo: N.F.B. 63-2802

Above:
Surveyors at work on the South Saskatchewan Dam project.

Centre:
The tellurometer in use.
At lower left (on the box) is a theodolite.

Below:
Surveying the route of a new highway, near Yellowknife, N.W.T.

Photo: N.F.B. 93661

to measure angles, the transit or the level. Elevations are computed from readings taken with the level on a rod (graduated in hundredths of feet) and held by the rodman. Distances are measured by the chainmen using a standard steel tape.

As head of the field party, the surveyor ensures the accuracy of the work by checking at various points and by reviewing the notes and other data obtained by the party. When the field work is completed, the surveyor returns to headquarters and works in an office preparing reports and drafting plans based on the survey.

The foregoing is only a brief outline of the surveying required to establish land boundaries or the route of a new highway: there are, in fact, many other aspects of surveying such as photogrammetry which is used to provide data for mapping contours and areas. In addition, the surveyor uses other equipment including the barometer and the plane table and alidade, the latter being used especially in mapping, and an optical device known as a stadia for certain types of distance measurement. Recent developments include the tellurometer and the geodimeter which require only one or two men to operate. The tellurometer uses a microwave system and sends out a radio beam from a master set to "slave" or receiving sets which are placed anywhere from 500 feet to 40 miles apart; the geodimeter is a similar device which uses light waves instead of radio waves.

Once the land surveyor has established the legal boundaries, other surveying functions are required on the construction site and this is often the work of resident engineers or other technical staff. Supervisors, foremen and others concerned with site preparation, excavating and levelling also use the transit, the dumpy level, measuring rods and other survey equipment.

Preparation and Training

Land surveying may only be practised by a legally authorized land surveyor, that is, a person who is commissioned by a Surveyors' Association; the associations are administered separately in each province. The federal government also commissions

surveyors for work on federal land (Yukon, Northwest Territories, National Parks, etc.).

Admission to a Surveyors' Association is obtained by serving a three-year articleship (four years in Ontario and Quebec; two years in New Brunswick) with a registered surveyor. High-school graduation with special ability in mathematics and physics is the minimum requirement on entry. In the province of British Columbia, a preliminary examination must be passed before admission to articleship.

During the training period, the student must present himself to the association for intermediate and final examinations which are held in provincial capitals. University graduates in civil engineering are exempt from intermediate examinations and may be admitted to an association after completing a shorter period with a surveyor—usually one year which must include practical field work—and successfully passing the final examination. Licence fees are required for membership and range around $100; in some provinces a bond is also required (in Ontario this is $1,000).

University training is advocated by the provincial associations as the most suitable route to a career in surveying. A course is offered at the University of New Brunswick leading to a degree in survey engineering; the curriculum covers three years of civil engineering, after grade 12, followed by two years of specialization in surveying. The University of Toronto offers a surveying option in the civil engineering program; this is a four-year course, after grade 13, with specialization in surveying in the last two years. For other types of surveying, such as mining and forestry, as well as hydrographic and geodetic surveying, university courses are also advocated.

The Nova Scotia Land Survey Institute, Lawrencetown, N.S., provides full-time courses of two years leading to a licence as a Provincial Land Surveyor. Full-time courses, also of two years, are given at the Institutes of Technology in British Columbia and Alberta with a two-fold purpose: to provide practical skills and a knowledge of surveying necessary to earn a living directly on entering the field; or to prepare students for the examinations of

the Land Surveyors' Associations. Following any of these two-year courses, the student must spend about one year in gaining practical experience.

Training may be obtained on a part-time basis through courses such as those available in plane surveying offered by the Correspondence Branch of the Department of Education, Halifax, Nova Scotia.

Others in the field party such as the instrument man (and the draftsmen back in the office) may be trained through an institute of technology program. Chainmen, rodmen and other helpers usually learn their skills on the job. All the foregoing jobs are done by student surveyors as part of their training.

Personal Qualities

Surveying is largely based on algebra, geometry, trigonometry and calculus as well as general science and physics, so that those most likely to succeed must have a definite interest in and the ability to visualize and work out the mathematical problems which arise.

While a sound theoretical background is essential, it alone does not ensure success—other definite traits of character are necessary. It is hard to overemphasize the qualities of accuracy, thoroughness and honesty; the location of a multi-million dollar project depends, in some measure, on the accuracy of the survey work as does the legal settlement of property disputes which arise from time to time.

As leader of a team, the success of a survey depends on the ability of the surveyor to organize, direct and inspire other team members. A courteous and affable manner is expected by the general public as is the ability to command respect.

Excellent health, sufficient strength to walk long distances over rough ground, and a pleasant disposition are required on field surveys. Manual dexterity and good eyesight are necessary to use and operate the intricate survey instruments.

Working Conditions

Working conditions vary considerably according to the branch of surveying or the nature of the employer's business. In general, field survey work may involve living at a campsite, hours of work may be irregular and living conditions rougher than those experienced at home. There are, however, many variants: those employed by a local authority may work in city streets or a new subdivision on the edge of town; engineering projects may be in remote and isolated areas; forestry surveying may be in bush country; topographical surveys are made north of the 60 degree parallel; other surveyors work in the mines.

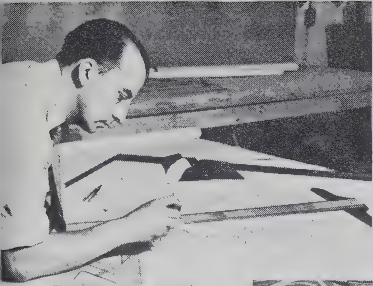
At the home base where field results are translated into drawings, the work is done in well-lighted and sometimes air-conditioned offices and except for limited overtime to meet certain time schedules, hours of work are regular.

The Technical Team

As previously mentioned, a number of engineering and architectural functions are delegated to the "technical team". The team comprises junior architects and engineers or specialists trained in one particular phase of construction. These specialists are dealt with only briefly in this booklet; they are covered at length in CAREERS IN DRAFTING and TECHNICIANS IN SCIENCE AND ENGINEERING (see inside front cover) to which the reader is referred for full particulars of preparation and training, working conditions and other details.

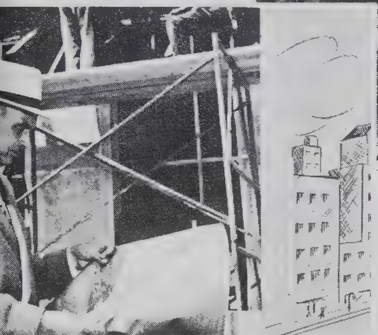
On the larger building and engineering projects, several or all of the following occupations will be found:

Estimators compute precise costs and amounts of materials, supplies, services and labour in the contractor's office and, on the basis of their work, contractors submit price quotations to the owner. Estimators may also be employed in an architectural or engineering office to compute the probable cost before contractors



bove: Topographical
drafting

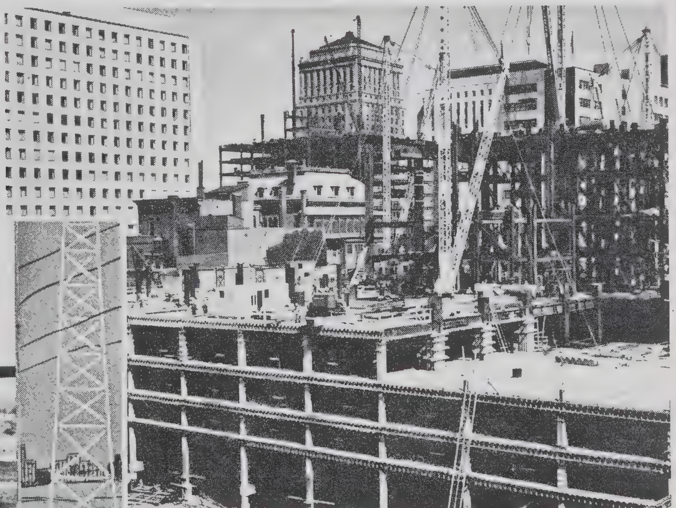
pper right: Surveying



These are a few of the many functions in building construction.

bove: Clerk-of-Works

elow: Supervisor
and foreman



are invited to tender. This function may be undertaken either by engineers or architects; alternatively, estimators may have advanced from supervisory positions or be trained through institutes of technology (see TECHNICIANS IN SCIENCE AND ENGINEERING).

Quantity surveyors—this is a relatively new occupation in Canada—may be employed to prepare schedules of materials and supply this information to architects, contractors and other clients.

Architectural draftsmen prepare presentation drawings of the proposed structure. They also incorporate design modifications and prepare the drawings to be used on the construction site. This may be a training position for junior architects or may be done by those trained in drafting technology (see CAREERS IN DRAFTING).

Engineering draftsmen are concerned with drawings of supporting framework for buildings, bridges and similar engineering structures and may be trainee engineers or trained specifically in structural drafting techniques.

Junior draftsmen—these are entry positions—prepare detailed drawings and tracings, under the direction of senior draftsmen, to be used on the actual construction site.

Model makers and *artists* are employed to make scale models for test purposes and ink or colour illustrations to help the client visualize the suggested design.

Clerks-of-Works—these may be registered architects—are appointed to the building site by the chief architect to check the progress and execution of the work.

Resident engineers, as the name indicates, are employed on the construction site to undertake liaison work between the engineers and the contractor's superintendents.

ON-SITE CONSTRUCTION WORKERS

Of the many on-site workers, a large proportion of those in engineering construction are trained "on-the-job" i.e., recruited initially as helpers or labourers and upgraded as they acquire the necessary skills through practical experience. In contrast, the majority of the workers in building construction are craftsmen normally trained through apprenticeship—a carefully regulated period of practical experience and classroom study and extending over several years. In most provinces, the building crafts are "designated" by Departments of Labour who supervise entry requirements, training and the other details summarized on page 40.

A number of occupations in the construction field offer an opportunity for those who leave school for various reasons to become an apprentice on completion of grade school. It must be pointed out, however, that many employers now require one or more years of schooling above the minimum laid down by provincial regulations.

Most construction projects employ apprentices who assist the craftsmen, together with a high proportion of helpers and labourers who handle materials and undertake routine work.

Preparation and Training

Young people while still in school can obtain preparation and training for entry into the construction field through shop courses designed primarily to acquaint the student with a number of manual skills. These courses give students an opportunity to discover the type of work which appeals to them most and may help decide whether they are prepared to spend the next three or four years in learning a craft.

Vocational Education

For those who have left school, courses are available in municipal and provincial trade schools which are either related to specific occupations such as carpentry or may provide a background for entry into one of several occupations. Both day and evening programs are provided, those related to specific occupations being of from six to ten months duration. The time spent in trade schools is usually deducted from the period of apprenticeship. Many of these schools also have courses for those who wish to upgrade their skills while in employment.

Apprenticeship Training

Building craftsmen serve an apprenticeship during which time the apprentice works for an employer and learns the practical side of the job under the direction of a journeyman—a worker who has completed an apprenticeship—and is also required to attend trade schools to be taught difficult techniques and the theory of the craft.

One of the main differences between apprenticeship and other types of training is that you work and are paid while you learn. An apprentice enters into a written agreement usually with an employer which states certain terms such as the length of apprenticeship, the amount of in-school training, pay scales (these vary from province to province and even from one district to another in the same province) and general working conditions. Starting wages are low but are increased every six or twelve months until the apprenticeship is completed.

In several provinces, the authority authorized to sign apprenticeship agreements, in addition to individual employers, may be a joint apprenticeship committee, an employer's association or a trade union. Prior to signing the apprenticeship agreement, a three- to six-month probationary period is usually allowed. All agreements allow for cancellation (subject to the approval of the regulating authority) if the arrangement is found to be unsatisfactory.

In addition to being instructed by the employer or his journeymen, apprentices are normally required to attend for several weeks of full-time classroom training each year of apprenticeship at trade schools operated by or for the province. These courses cover the theory and practices of the craft together with related educational subjects. Apprentices attending full-time classes are paid living and travelling allowances. Where it is difficult to attend full-time courses, the equivalent may be possible through evening or correspondence courses.

On completion of apprenticeship, trade tests are given and the apprentice is awarded a certificate. Interprovincial standards for the examination of graduating apprentices have been established in a number of crafts and those who reach these standards are awarded a certificate bearing an interprovincial seal recognized in most provinces as a certificate of competence without further examinations.

In the province of Quebec, apprenticeships are controlled in certain areas by Parity Committees representing employers and labour. In these areas, the normal method of entry into the building crafts is to attend thirty-five weeks of full-time pre-employment training at one of the following centres: Montreal, Sherbrooke, Quebec, Vaudreuil, Granby, Hauterive, Alma, Joliette, Chicoutimi, Maniwaki or Hull. This is followed by three years of training with an employer during which time the apprentice is encouraged to attend additional day or evening classes. Employers may take apprentices who have not passed through a training centre but in the listed areas these apprentices must enroll for evening classes or lose their registration. On completion of training, all apprentices in Quebec are trade tested and if successful are awarded a "Competency Card" denoting journeyman status.

A good source of information on how to enter an apprenticeship is the Director of Apprenticeship in a province (addresses are given on page 41). He can sometimes provide a list of firms offering apprenticeship and can give other advice and assistance.

BUILDING CRAFTSMEN—DESIGNATED BY PROVINCES

PROVINCIAL REQUIREMENTS	Carpenter	Electrician (Construction)	Painter and Decorator	Plumber	Steamfitter	Gas Fitter	Plasterer	Cement and Concrete Finisher	Bricklayer	Tilesetter	Sheet-Metal Worker	Structural Steel Worker	Welder	Remarks
BRITISH COLUMBIA														
Apprenticeship—years	4	4 to 5	3	5	5		4		4		4 to 5	3	3	Also air-conditioning and refrigeration (And in Alta., Sask., Man., Ont. and N.S.)
*School Program	4-4-4-4	8-8-8-8	4-4-4	4-4-4-4-4	**		4-4-4-4		4-4-4-4		4-4-4-4	4-4-4	**	
Minimum Education—grade	N/A	N/A	N/A	N/A	N/A		N/A		N/A		N/A	N/A		
No. of Registered Apprentices	296	347	50	192	39		11		33		145	31		
ALBERTA														
Apprenticeship—years	4	4	3½	4	4	3	4		4	4	4		3	
*School Program	8-8-8-8	8-8-8-12	4-8-8	6-6-6-6	6-6-6-6	3-0-3	6-6-6		8-8-8	4-4-4	10-8-6-8		6-6-3	
Minimum Education—grade	9	10	9	9	9	9	9		9	9	9		9	
No. of Registered Apprentices	219	702	73	454	98	54	36		74	25	270		560	
SASKATCHEWAN														
Apprenticeship—years	4	4	3	5			3		3		4		4	
*School Program	8-8-8	9-9-9	6-7	6-6-6-6			N/A		12-6		7-7-7		6-6-10	
Minimum Education—grade	8	10	8	8			8		8		10		8	
No. of Registered Apprentices	272	181	27	217			N/A		69		71		44	
MANITOBA														
Apprenticeship—years	4	5	4	5	5		4		4		5			
*School Program	8-4-6-4	8-6-6-0-4	8-6-0-4	8-0-6-0-4	6-0-4-0-**		8-6-0-4		8-6-0-4		6-6-6-**-4			
Minimum Education—grade	9	10	9	9	9		9		9		9			
No. of Registered Apprentices	127	360	91	203	76		30		67		93			
ONTARIO														
Apprenticeship—years	4	4	4	5	5		4		4		4			
*School Program	10-10	10-10	10-10	10-10	10-10		10-10		10-10		10-10			Some Union Agreements require Grade 12
Minimum Education—grade	8	8 f	8	8	8		8		8		8			
No. of Registered Apprentices	187	998	50	689	207		23		56		479			
QUEBEC														
Apprenticeship—years	4	4	4	4			4	2	4	4	4	2	4	
*School Program	35-1-1-1	35-1-1-1	35-1-1-1	35-1-1-1			35-1-1-1		35-1-1-1	35-1-1-1	35-1-1-1	N/A	35-1-1-1	
Minimum Education—grade	7	7	7	7			7	7	7	7	7	7	7	
No. of Registered Apprentices	N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A	N/A	N/A	N/A	
NEW BRUNSWICK														
Apprenticeship—years	4	4	3	5			3		3		4			
*School Program	39-**-**	39-**-**	cc.	39-**-**			**		39-**-**		**			cc.—Correspondence courses only
Minimum Education—grade	8	9	8	9			8		8		8			
No. of Registered Apprentices	173	171	7	144			N/A		N/A		46			
NOVA SCOTIA														
Apprenticeship—years	4	4		5	5				4		4			
*School Program	5-5-5-5	5-5-5-5		4-4-4-4-5	**				5-5-5-2		5-5-5-5			
Minimum Education—grade	8	8 or 10†		8 or 9†	8				8		8			†Under review
No. of Registered Apprentices	143	166		163	34				63		71			
PRINCE EDWARD ISLAND														
Apprenticeship—years	4	4	4	5	4				4		4		4	
*School Program	4-8	4-8	4-8	4-8	4-8				4-8		4-8		4-8	depending on year of apprenticeship
Minimum Education—grade	11	10	11	9	11				8 or 11		11		11	
No. of Registered Apprentices	N/A	N/A	N/A	N/A	N/A				N/A		N/A		N/A	
NEWFOUNDLAND														
Apprenticeship—years	4	4		5										
*School Program	8-6-4-4	8-6-6-5		8-6-6-5-5										
Minimum Education—grade	8	10		9										
No. of Registered Apprentices	61	106		82										

* Weeks of full-time attendance in each year of apprenticeship or equivalent. ** Evening classes. N/A Details not available.

April 1964

TABLE 1—APPRENTICESHIP REQUIREMENTS

FURTHER INQUIRIES

Further information on apprenticeships in your province can be obtained from:

Newfoundland:
Director of Apprenticeship,
Department of Labour, ST. JOHN'S, Nfld.

Prince Edward Island:
Director of Apprenticeship,
Department of Education, CHARLOTTETOWN, P.E.I.

Nova Scotia:
Director of Apprenticeship,
Department of Labour, Provincial Building, HALIFAX, N.S.

New Brunswick:
Director of Apprenticeship,
Department of Labour, P.O. Box 906, FREDERICTON, N.B.

Quebec:
Director of Apprenticeship,
Department of Labour, 5205 Parthenais St., MONTREAL, P.Q.

Ontario:
Director of Apprenticeship,
Department of Labour, 8 York St., TORONTO 1, Ont.

Manitoba:
Director of Apprenticeship,
Department of Labour, Norquay Bldg., WINNIPEG, Man.

Saskatchewan:
Director of Apprenticeship,
Department of Labour, Administration Bldg., REGINA, Sask.

Alberta:
Director of Apprenticeship,
Department of Labour, Terrace Bldg., EDMONTON, Alta.

British Columbia:
Director of Apprenticeship,
Department of Labour, 411 Dunsmuir St., VANCOUVER, B.C.

Carpenters

Carpenters work primarily with wood and are traditionally associated with the construction industry because of the extensive use of timber for building purposes. They form the largest single group of building craftsmen for their skills are needed at all stages of construction—from the installation of forms which support the concrete foundations to the last cupboard door.

In addition to the carpenters at the construction site, many are employed in plants which manufacture prefabricated units ranging from doors and garages to sections of houses and are assisted in this work by bench hands and the operators of jointers, planers, shapers and other power-driven equipment. Alteration, repair and maintenance of existing structures is another important field of work in which carpenters may specialize.

Other related though separate crafts in woodworking include *cabinet makers* who make furniture or similar intricate work, and *patternmakers* who are employed in foundries and related industries. (The occupation of patternmaker is covered at length in METAL WORKING OCCUPATIONS—see inside front cover.)

Within the construction industry, there is further specialization. Carpenters on a small site where perhaps one or two houses only are being constructed—and in maintenance and repair work—are usually *general carpenters* with all-round skills. The general carpenter will be required to carry out any or all of the following: estimate amounts of materials and labour; prepare sketches using his knowledge of local and other building regulations; and layout, cut and install all woodwork—from the rough framing to the finishing trim. Others may specialize, particularly on large construction projects, and concentrate on one of the following: frame carpentry—the erection of floor joists, wall studs, rafters and similar supporting framework; form building—the construction and installation of wooden supports for the concrete which is used extensively in dams, tunnels, foundations, reinforced concrete, roof

Photo: N.F.B. 63-6985

Form carpenters at work on the Port Blandford Causeway, Nfld.

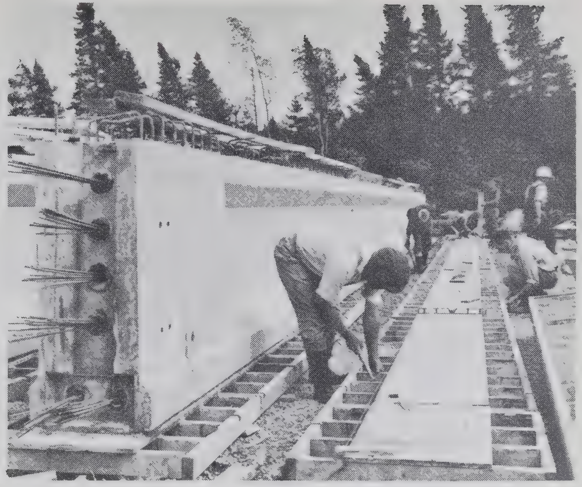


Photo: N.F.B. 47741

Laying of sub-flooring during housing construction in Whitehorse, Yukon.

Photo: N.F.B. 93796

The handsaw is still an important tool but is being replaced by power equipment.

slabs and exterior sheathing; and finish carpentry which includes exterior and interior trim, doors, wall panelling, door hanging and stair building.

All carpenters must be skilled in the use of hand and power-operated tools, must be able to visualize the finished structure, read blueprints and understand oral instructions. They are required to install prefabricated units such as doors and windows and know the working properties of such materials as composition board, plastics, asbestos and metal which may be used in place of wood.

Entry into the craft of carpenter is through apprenticeship (see page 37). During this period, the apprentice is taught the use of tools, gains a knowledge of wood and other materials and learns how to plan and carry the work out to completion in an efficient manner. He also acquires manual skills and a thorough understanding of woodworking processes and their relationship with other building crafts. Related classroom instruction will include mathematics (with some geometry), sciences including the strength of materials, mechanical drawing and similar subjects together with additional instruction and practice in woodworking techniques. Apprentices must purchase a kit of tools over a period of several years and which may cost several hundred dollars.

Carpenters require a sturdy physique to lift and secure into place heavy wooden sections and units. Climbing and balancing on ladders and scaffolding and the ability to stand for long periods, to kneel, bend and to work in confined spaces are also required.

The usual line of promotion at the construction site is from apprentice to journeyman. If the carpenter can handle men, he may advance to foreman and possibly supervisor; it must be noted, however, that few supervisory positions are available. Many carpenters at some time in their careers undertake subcontract work, that is, provide labour at a fixed price; from these small beginnings, some carpenters have been able to develop their own businesses or open their own wood-working shops.

In common with most workers at the construction site, the carpenter is exposed to extremes of weather and will probably encounter layoffs during the winter months. New techniques, however, and incentive programs are reducing the duration of seasonal slack periods. Maintenance and repair work continues on a year-round basis and is less affected by seasonal changes.

There are some occupational hazards such as falls from scaffolding, cuts from power equipment and injuries from falling objects; these are considerably minimized by strict attention to safety regulations.

Bricklayers and Stonemasons

The main task of the *bricklayer* is to set out and lay bricks, structural tile, ceramic veneer, artificial stone and blocks of concrete, glass and other structural materials for a wide variety of building projects. These projects range from load-carrying exterior walls, internal partitions and similar structures at any level—above, below or on the ground—to the execution of ornamental details such as fireplaces.

Typical of the bricklayer's work is the construction of a new dwelling. The first step is to "set up" and indicate on the foundations where bricks or other building materials have to be laid. This is usually done by the foreman who arranges lines of thin cord from wooden frames previously set at the corners of the proposed building. He then trowels bonding material such as mortar onto a brick and places it exactly at the point where the lines intersect. This he repeats at all corners; then he marks the wooden frames to show where each layer or "course" of bricks must be placed. At the same time, he marks the position of such features as door openings and may use templates for circular or special shapes. Setting out calls for extreme accuracy; the ability to read architectural drawings; skills in the use of plumb boards, spirit levels, rules and straight edges; and a knowledge of the principles of construction.

Photo: N.F.B. f/s

Setting the line for "straight run" bricklaying.

Photo: N.F.B. f/s

The bricklayer needs a good eye for straight lines.

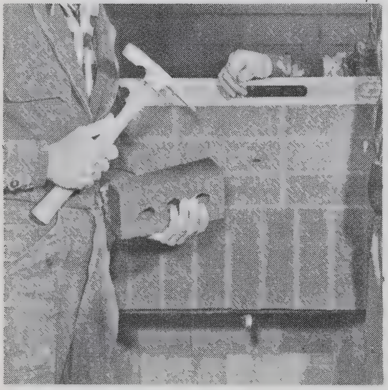
Photo: N.F.B. f/s

Laying concrete blocks on an interior wall.

Photo: N.F.B. f/s

Blocks of stone are hoisted into position.

Photo: N.F.B. f/s



On smaller jobs, bricks are cut with the hammer.

Photo: N.F.B. f/s

Laying decorative patterns around this fireplace requires artistic skills.

When the setting out has been completed, a team of bricklayers and apprentices, assisted by labourers who keep them supplied with materials, lay several courses of brick in triangular form at each corner of the structure and ensure that the courses are straight and level using tools similar to those required in setting out; when necessary, bricks are cut with power-operated saws or, on the smaller projects, with hammers, chisels or a sharp blow of the trowel.

Next, the bricklayers stretch a line to act as a guide between the corners and lay straight runs of bricks. Raising the line course-by-course they fill up with brick to the highest level of the corners; scaffolding is then erected by the labourers and bricks are laid until the wall is built to the required height. Finally, to improve the appearance and damp-resisting qualities of the wall, the joints are pressed with a steel roller or "pointed" (filled) using a small trowel.

While all bricklayers use similar techniques to those just described, this is "straight run" or the simplest form of bricklaying. There is, in fact, considerable variety both in techniques and materials used. The steel framing of an engineering structure may be clad with decorative patterns of brick or other veneering materials; this calls for considerable skill in cutting and arrangement. Bricks may be supplied in varying shades which the bricklayer arranges in pleasing patterns; this calls for artistic talent and a good eye for colour blending. Ornamental work may include archways, decorative pillars and other variations on straight bricklaying, all of which calls for additional skills.

In addition to work on new structures, bricklayers are employed in firms which specialize in the repair, alteration and renovation of existing buildings. This includes a full range of work, from repairing a cracked wall to adding a new room to the building. Repair and similar work requires a good knowledge of the principles of construction since the bricklayer must not only repair the damage but must discover the cause.

Bricklayers are also on the payroll of hospitals, real estate companies, municipal authorities and manufacturing concerns where they are primarily engaged in repair and maintenance work. Special types of work such as lining furnaces in steel making plants, building industrial chimneys and lining tunnels in mines are also undertaken; this work requires special skills and the bricklayers may be trained by the manufacturing concern.

Bricklaying is a highly skilled craft and entrance is gained through apprenticeship (see page 37). In a typical apprenticeship program, the apprentice will learn the following: the care and use of the tools and equipment which have been mentioned; how to level a site, using such instruments as a dump level or theodilite, and how to set up corners, how to build fireplaces, chimneys, arches, buttresses, columns and piers; and to cut, shape or otherwise work stone, glass, concrete and other related

Photo: N.F.B. 55333

The cloister of the Benedictine Monastery, St. Benoit-du-Lac, Quebec, presents a fine example of the bricklayer's craft.

materials. Classroom instruction in the trade schools provides instruction in techniques which are difficult to learn on the job and also includes: drafting and sketching; blueprint and specification reading together with instruction in building code regulations; mathematics (calculating areas, volumes and bending forces and the geometry of ellipses and circles); sciences and the properties of materials. During the apprenticeship period, apprentices must equip themselves with trowels, hammers, squares and measuring equipment; the cost is quite reasonable—less than $100.

The work of the *stonemason* is similar in many respects to that of the bricklayer except, as the name indicates, he works with stone slabs and blocks. Often the blocks require considerable "dressing" (cutting to shape) either at the construction site or back at the masonry yard. In addition, the stones are usually much larger than bricks and may have to be hoisted into position.

In the masonry yard, sections of stone are cut into building blocks with power-driven saws and, as detailed in architectural drawings, may be further shaped with power-driven lathes and shapers. Decorative patterns may be cut to metal templates using hand-held chisels and hammers or similar tools operated by compressed air. Finally, hoisting holes are cut and the blocks may be polished with hand-held rotary grinders. This work requires good control of the hands and a delicate touch, patience and a genuine interest in the work; in return stonemasonry offers the pleasure of creative work.

While the workers in the masonry yard can produce geometrical and other decorative shapes to prepared patterns, functions such as carvings, lettering and monumental work are carried out by those trained as artists rather than stonemasons.

At the construction site, the job of the mason is quite different from that in the yard. Small buildings are constructed of stone using techniques similar to those of bricklayers and, in fact, stonelaying may be regarded as an extension of the bricklayer's craft. However, stone is used for churches, civic buildings and other prestige structures; in addition renovation of the stone used in historical and similar buildings is required.

The mason's skills lie mainly in placing blocks of stone, usually of considerable weight and size, accurately in position with the aid of crowbars, pulley blocks and other hoisting tackle. The spirit level, rule and straight edge are in constant use but the mason exercises considerable judgment. Although the stones are shaped in the masonry yard, they require further dressing with chisels and heavy hammers before they will fit exactly in position. Holes also have to be cut to accommodate bolts and clips which are used to secure the stones to steel framework.

Restoration work is similar to new construction except that decayed or damaged stone has to be cut away with chisels and drawings have to be made of the old stones. Replacement blocks are made either on the site or back in the yard and are then hoisted and fixed in position.

Bricklaying and stonemasonry are strenuous crafts undertaken in the open air and require prolonged standing and frequent bending or stooping to lift materials, therefore good physical condition is necessary. Skills with the hands in the use of trowels and a good eye for straight lines and proportions are also required.

There are several opportunities for advancement. Those who can set and lay out building materials can advance to foremen; several superintendents are employed on the larger building sites; estimation work in the contractor's office is another possibility. Some craftsmen become subcontractors or even general contractors since the initial financial outlay is reasonable.

Bricklayers and stonemasons are affected to a considerable extent by seasonal conditions and, although many new techniques have been introduced to extend the building season, lay-offs can be expected during periods of extreme cold weather. In turn, considerable overtime is available during the summer months. A few bricklayers have offset periods of unemployment by acquiring additional skills such as tile setting or plastering.

There are some occupational risks involved in working at heights but these are considerably minimized by municipal and provincial safety regulations. The work is hard on the hands and tends to be dirty; there is some risk from dust during stone cutting and masks are required to be worn.

Structural Metal Workers

Extensive use is made of prefabricated steel members, reinforcing iron rod and metal mesh in commercial, industrial and the larger residential establishments, in bridges and tunnels and in such structures as radio and microwave towers.

Assembly, erection and installation of these metal components are undertaken by the workers about to be described. Several distinct occupations are explained although it must be appreciated that some workers are skilled in several or all of the following phases of structural metal work.

Reinforcing iron workers (rodmen) are chiefly employed in setting iron or steel bars to reinforce the concrete which is used in beams, piers, walls, floors, roofs and similar parts of a building. As necessary, the rodmen cut, bend and install the bars according to engineering drawings or verbal instructions and secure them in position with wire, metal clips or by welding.

In addition to metal rod, coarse metal mesh is used to reinforce roofs, floors and, particularly, the surfaces of highways. This also is the work of rodmen who measure the surfaces to be covered, cut and bend the mesh and secure it in position where the concrete is to be poured.

Structural steel workers usually work in a team which will include *riggers, finishers, crane* or *hoisting equipment operators* and may include specialists such as *rivetters* or *welders.*

From engineering drawings, the structural steel worker determines the correct layout and location and arranges the steel members in a sequence ready for erection. Hoisting equipment and perhaps metal scaffolding may have to be erected and, although this is usually done by equipment operators and helpers, the structural steel worker may direct or assist in this work.

Steel members such as girders, beams or sections are made by other workers in metal-fabricating plants.* The members are secured to the hoisting equipment and raised into position; the

* These and similar occupations are described in METAL WORKING OCCUPATIONS in this series.

Photo: N.F.B. 94513

Structural steel workers move high above the city.

Photo: N.F.B. 94503

Hand signals are used to direct the crane operator.

Photo: N.F.B. 85409

Girders are aligned and temporarily secured with bolts.

Photo: N.F.B. 94524

Using a jackhammer, the rivetter permanently secures the girders of the Narrows Bridge, Vancouver, B.C.

Photo: N.F.B. 62-1948

Iron workers lay reinforcing rods before concrete is poured on the International Bridge, Sault Ste. Marie, Ont.

Photo: N.F.B. 62-1949

After installation, the rods are levelled and are then welded in position.

structural steel worker directs the hoisting engineer with hand signals. The structural steel worker checks the member with a plumb board and spirit level and aligns the holes by driving a drift pin into them. The drift pins are then removed and the members temporarily secured with bolts. Welding or rivetting crews later remove the bolts and complete the final assembly. Rivetting crews consist of a *rivet pusher*, a *rivet heater* who heats the rivets in a forge and tosses them to a *rivet catcher*; a *bucker-up* who holds a tool on the head of the rivet while a *rivetter* hammers the rivet shank with an air-driven hammer.

Ornamental iron workers install grilles, iron ladders, catwalks, fire escapes, stairways and similar fixtures and also undertake decorative metal work for enclosures such as fences, balcony railings and gates. In addition to working with iron they are skilled in the use of aluminum, brass and bronze.

Usually ornamental or decorative metal work is prefabricated in metal working shops but may require cutting and assembly on the construction site before installation. As required the ornamental iron worker assembles, bolts or welds the parts into complete units and sets them in position with concrete.

Apprenticeship is the recommended route to structural metal work and is a requirement in the provinces of British Columbia and Quebec. However, a large number of workers enter the industry as helpers and, over a number of years, acquire sufficient experience to advance to structural steel workers. Trade or vocational school training in such subjects as blueprint reading, metal working, welding and flame-cutting provide valuable pre-employment training.

In a typical training program, the apprentice learns how to cut, drill and shape with hand tools or power-operated equipment; how to read engineering drawings and from them how to layout and assemble metal structures. In addition the apprentice learns welding, flame cutting, bolting and rivetting, and the use of slings, cranes and other hoisting equipment.

Employment is chiefly outdoors where the workers are exposed to adverse weather conditions. Agility and a highly developed

sense of balance are prime requisites since the work is often done at great heights from narrow footings. Prefabricated members are bulky and heavy and above average strength is necessary. Considerable travelling is involved since there is insufficient local work to keep the crews fully employed except in the larger cities.

Opportunities for advancement are limited to openings which occur as foremen and construction supervisors.

Roofers

Roofers apply tiles of composition, asphalt, asbestos or burnt clay to the roofs of buildings or coat them with tar, asphalt or other bituminous materials to provide protection against the weather; sheet metal such as tin, copper or galvanized iron may also be used to provide similar protection. Their work also includes waterproofing or weatherproofing walls and other surfaces of buildings.

In applying composition roofing, the roofer first covers the entire surface with overlapping strips of asphalt or tarred paper which are nailed or secured with adhesive to the wood sheathing of the building. Where necessary, the roofer cuts and trims the strips to fit around pipes, chimneys and other outlets. Where surfaces intersect, such as those between a chimney and the roof, the roofer nails metal or asphalt strips known as "flashing" to render the joints waterproof.

Tiles are then placed over this covering in such a way that they overlap the preceding rows and are nailed in position. Finally, exposed nailheads are covered with roofing cement to protect them from the weather. In this work, hand tools are mainly used and consist of the roofing hammer (which is also used to cut tiles), knives, pincers and caulking guns.

Roofers may also cover a roof with several coats of hot tar, pitch or asphalt which is brushed on and finished with small pebbles to protect the roofing materials from the weather.

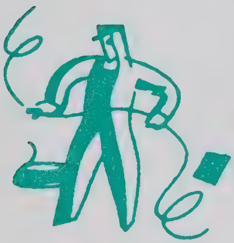
Metal roofs are constructed by soldering or overlapping sheets of metal together and nailing them to the wooden sheathing of the building. Again, nailheads are covered with roofing cement to avoid water leakage.

Most of the roofers have learned their skills by entering the trade as helpers, except in the province of Quebec which provides an apprenticeship program (see page 37).

This work is entirely in the outdoors and, because of this, is seasonal in nature. It is fairly strenuous and involves kneeling, bending and stooping. Considerable agility is necessary as is the ability to work at heights.

There are few occupational hazards except those associated with working at heights and the risk of burns from hot materials.

Advancement is limited to the few openings which occur with the larger roofing contractors as foremen. A number of roofers are self-employed or act as subcontractors to the main building contractor.



Electricians

In the construction industry, *electricians* undertake new electrical installations on buildings or engineering projects or alterations to, or extensions of, existing installations. There are many other fields of work in which electricians may be engaged. In maintenance work, they service and repair electrically operated machinery and other equipment used in industry or the systems supplying electrical power to the machinery. Others install and maintain electrical equipment in a variety of industries and may be known as "ship electrician", "aircraft electrician" and so on. This booklet will describe electricians in the construction industry; there is another booklet in this series, ELECTRICAL AND ELECTRONIC OCCUPATIONS, which gives detail on industrial and maintenance electricians and also includes information on many other electrical occupations in power generation, telecommunications and broadcasting.

Photo: N.F.B.

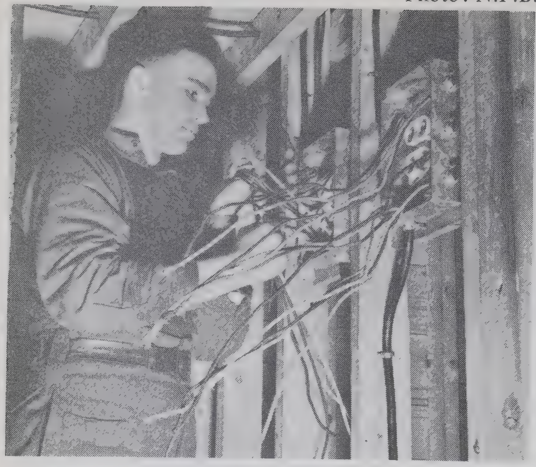
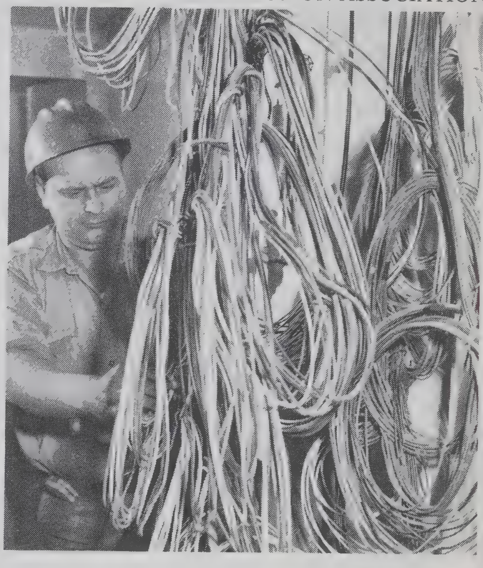


Photo: CANADIAN
CONSTRUCTION ASSOCIATION

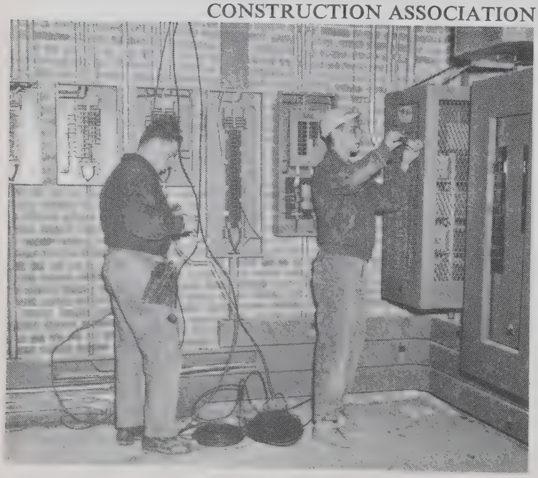


Above:
"Roughing-in" wiring and cables before the walls are completed.

Centre:
Wiring is identified by colour codes

Below:
Fuseboxes and panels are installed at a later stage.

Photo: CANADIAN
CONSTRUCTION ASSOCIATION



The basic work of all electricians includes the following: layout, installation, maintenance and testing of electrical circuits, fixtures and apparatus, signal systems and control equipment used in the lighting, heating, air-conditioning and other systems in buildings. They are required to use and maintain hand and power tools, portable equipment and testing and measuring instruments. A thorough knowledge of the Canadian Electrical Code is required since it must be adhered to in certain regions and types of work. In addition, they must know and comply with local, provincial or municipal regulations.

Duties of the *construction electrician* depend on the type of building project but are usually in four main steps. First someone has to work out how the job is to be done and this is known as "layout". Then wiring, cables and conduits are run between the supply points and the points where the current is to be used. Next, switch boxes, pull boxes and other concealed equipment are installed before the walls are plastered and the floors laid. At a later stage in the building program, various fittings are installed such as service panels, transformers, meters, lights, motors and power equipment and the specialized gear needed in a particular industry. Finally, the whole installation must be tested before the main supply can be safely connected. There are two important tests to be carried out; one is to ensure that the installation is connected efficiently and correctly and the other, that the installation is safely insulated. For these tests, measuring and resistance testing instruments are used.

The degree of responsibility varies with the extent of the project. On larger projects, installations are made according to drawings prepared by electrical draftsmen: on smaller jobs, the electrician is responsible for the complete installation including planning, layout, testing and conformity to regulations.

Entry to the craft of electrician is through an apprenticeship program (see page 37). Related classroom tuition will include the study of mathematics (more advanced than that required by most other building trade craftsmen), physics, electrical theory and some electronic theory in addition to practice in electrical

techniques in a laboratory. On completion of apprenticeship, it is necessary to qualify by examination for a journeyman's certificate. It is also necessary to obtain a licence by passing the tests of either a province or a municipality before the craft can be practised in a particular locality. Most electricians are required to purchase a kit of tools during their apprenticeship.

Among the most important qualities needed to be successful as an electrician are:

A keen sense of responsibility—electricity is safe when properly used, but slipshod or careless work could easily cause a fire or fatal accident.

Self-reliance and confidence—an electrician often works alone without supervision and must make many decisions.

Methodical approach and common sense are important—there are several ways of doing most installations.

Good colour vision is essential (electrical cables and equipment are identified by colour coding) as is the ability to work at heights or in confined spaces.

Cleanliness and neatness, both in work habits and in person, are expected since the work takes him into homes and offices.

A sound knowledge of mathematics and science, the ability to write an account of the work, to understand specifications and drawings together with sufficient aptitude to benefit from vocational school training are required.

While the electrician, like other craftsmen, can find sufficient satisfaction in the interest of his job, ever increasing use of electricity offers good prospects of promotion to the competent worker who has mastered the principles of the craft and has the right personal qualities. The path of advancement in the construction industry leads to foreman or supervisor or to inspection work and may lead to self-employment as an electrical contractor.

Electricians may work considerable overtime in summer with some slackening off or unemployment during the winter; however, they are less affected by the weather than most other construction workers.

Plumbers and Pipefitters

In the construction industry, *plumbers* are primarily concerned with the installation of piping systems and fixtures required to provide hot and cold water or to dispose of sanitation wastes in homes, schools, public buildings and places of employment. In addition to new construction work, plumbers repair, maintain or remodel plumbing systems in existing buildings.

Although both plumbing and pipefitting are included in the plumber's craft particularly in the smaller centres, some craftsmen specialize in either plumbing or in certain types of pipefitting: *steamfitters,* for example, confine their work to the installation and maintenance of the metal piping which is used to carry low- or high-pressure steam in commercial and industrial establishments; *gasfitters* work with the systems which carry gas from the storage or generating plants to distribution centres and thence to homes and other buildings; *pipefitters* are employed on the complex piping systems used in oil refineries and petro-chemical plants and also work in shipbuilding yards, pulp and paper mills, food-processing plants and mines.

Typical of the construction plumber's duties is the work undertaken to equip a new home. The plumbing contractor examines the architectural drawings and arranges, as far as possible, to use standard-sized parts and for non-standard pipe and other sections to be cut, bent and threaded on power-operated hacksaws, thread-cutting machines, power benders and other machinery in the plumbing shop. A certain amount of cutting and other fabrication, however, still remains to be done on the construction site. The contractor also provides sketches and other instructions to the plumbers who are sent to the construction site.

On the construction site, the plumbers measure and mark out the location of holes through which pipes will pass and where faucets, sinks and other fixtures will be installed. Before the walls and floor are finished with wood and masonry, the plumbers start to "rough in" all piping which will later be covered.

From the main water supply in the basement, vertical pipes are installed up through the floor into the kitchen and bathroom. The pipes may have to be sawn and connections made to join the sections, valves, Y-branches, T-joints and elbows and other couplings installed. From the couplings in the vertical pipes, other sections of pipe are laid between the floor joists and wall studding. Outlets are left so that fixtures can be installed when the walls and floor are completed.

Further piping installations, known as sanitary plumbing, also have to be laid to dispose of wastes and for drainage purposes. Cast iron pipes with overlapping bell joints are commonly used although sanitary piping may be of galvanized steel, copper, lead or vitrified clay, each of which requires its own type of connection.

The work of the plumber does not end with the installation of piping systems for components such as the following have to be installed: traps to prevent sewage gases from entering a building; catch basins to trap kitchen wastes; drain tiles to prevent water from seeping into the building; and venting pipes are required to maintain the plumbing systems at the correct air pressure and so avoid syphoning action.

When the roughing-in has been completed, some fixtures such as the bathtub whose contours have to blend into a wall may be installed. Usually, however, the carpenters and plasterers finish the rooms and the plumber then installs sinks, toilets, faucets and perhaps radiators by connecting them to the waiting pipes at the various outlets.

Finally the system has to be tested for leaks. Since all plumbing work must be in accordance with municipal regulations, testing is done under the supervision of a representative of the public health or other department of the municipality or province.

In maintenance and repair work, the plumber is primarily engaged in locating and remedying defects in systems already installed. This may consist of removing defective pipe and cutting, bending and installing replacement items; soldering and caulking leaks; opening clogged drains with a vacuum plunger or a plumber's snake; replacing worn washers or other parts in leaking valves or faucets; and repairing or replacing damaged fixtures.

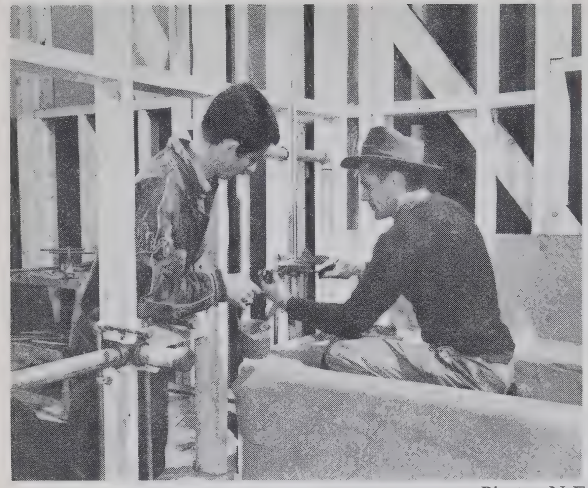
Pipefitting is similar to plumbing in that the system has to be laid out in accordance with drawings; pipes are cut, bent and threaded with hand or power-operated tools, and the pipe sections are assembled and installed. Steam, refrigeration and similar pipes are usually under pressure and, in consequence, methods of making pipe joints are different from those used in plumbing work: gaskets are commonly used and the sections bolted and caulked; sealing materials may be used while other joints are welded.

From the foregoing it will be realized that plumbers and pipefitters use a variety of skills. In the installation of water, waste and other systems, many different parts are fabricated on the construction site using hacksaws, reamers, pipe cutters, hand-held hydraulic benders, screw-thread cutters and other hand tools. Piping may be of iron, lead, copper, plastics and, depending on the material, joints may be bolted, welded, soldered or brazed, thus skills with wrenches, welding equipment and blowtorches are required. The ability to read architectural drawings is necessary, accurate measurements must be made and all work must undergo rigid inspection to ensure that it conforms with public health and other standards.

The craft of plumbing is learned through apprenticeship (see page 37). On completion of apprenticeship (or when moving from one locality to another), plumbers are required to obtain a licence by qualifying examination before they can follow their craft. Licensing procedures vary considerably; in the four western provinces, examinations are set by the provincial authorities which enable the plumber to practise anywhere in the province; in the province of Quebec, plumbers must pass the tests of the Provincial Board of Examiners; elsewhere, licensing is the responsibility of each separate municipality. Licence fees also vary and range from $1 to $200.

Some tools are usually supplied by the employer although many craftsmen purchase their own rules, wrenches, screwdrivers and other hand tools during their apprenticeship as a matter of convenience.

Photo: N.F.B.



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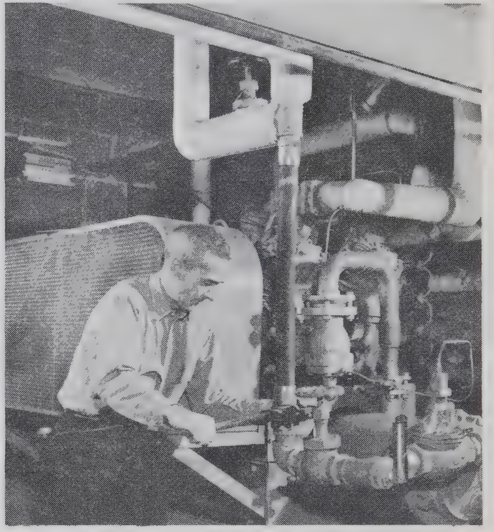


Above and below:
Before the walls are completed, the plumber and his apprentice "rough-in" piping which will be later covered.

Centre:
The pipefitter rectifies a leaking joint on this air-conditioning system.

Photo: N.F.B. 69482

Working conditions vary with the size and scope of the employer's business. The plumber may work alone except for an apprentice or may be one of a group of plumbers sent to the construction site. Plumbing may be done outside from ladders or scaffolding, or down a sewer and the work is often dirty. However, more than half the plumbing is indoors and, because of this, the plumber is considerably less affected by seasonal weather conditions. In addition, the plumber can find employment in repair work during slack periods in new construction and is usually employed on a year-round basis.

As a licensed craftsman, the contributions the plumber makes to the comfort and well-being of society earns him confidence and respect. Depending chiefly on skill and the ability to assume responsibility, the journeyman may advance to foreman. After further municipal or provincial examinations, he can be licensed as a master plumber and, as such, operate a plumbing business. Plumbers may also take additional training and become municipal inspectors or sanitary engineers.

Sheet-metal Workers

Sheet-metal workers on the construction site are primarily concerned with the installation of prefabricated ducting and associated components used in ventilating, heating and air-conditioning systems. They also install metal roofing, wall sidings, drainage gutters and the partitions, shelving and other metal framework required in residential, commercial and industrial establishments.

While it is the usual practice for ducting to be made in a sheet-metal shop and delivered to the construction site ready for use, there is a limit to the amount of prefabrication which can be done. Ducting and other metal work has to be made or adjusted to fit available space and to meet a wide variety of structural conditions on the site.

In the sheet-metal shop, the sheet-metal worker determines the size, gauge (thickness) and kind of material (galvanized sheet, tinplate and so on) and marks out the metal as necessary.

The metal is then cut with power shears, shaped on presses, bending brakes and other power-operated machinery and holes are cut and drilled. The sheet-metal worker then welds, rivets, seams or otherwise joins the parts into finished sections. In the larger sheet-metal shops, this fabrication is divided among operators who are skilled in the use of one machine only such as the bending brake or in a single function such as welding.

At the construction site, the sheet-metal workers set up a small, portable workshop—often the back of a truck—where vices, anvils and perhaps bending equipment or hand guillotines are available. Here the prefabricated sections are cut and trimmed to suit the installation. Alternatively, sheet-metal is marked out with rules, calipers and drawing instruments, is cut with hand shears, formed with hammers and mallets and joined to produce the ducting required on a particular site.

Brackets and hangers to support the ducting are secured to the wooden framework of the building, the sections of ducting are fitted together and are installed on the brackets. The joints may then be bolted, welded or soldered and covered with leakproof materials.

Many sheet-metal workers are employed in industries which manufacture such products as automobiles, agricultural implements, boats and domestic appliances; these, and other production workers, are covered in METAL WORKING OCCUPATIONS in this series.

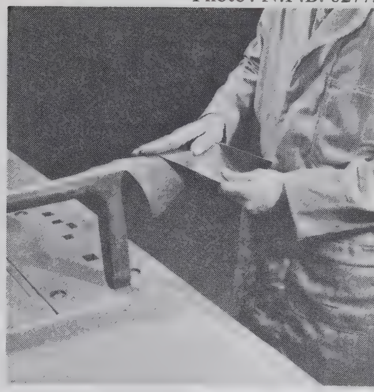
Sheet-metal work is learned through apprenticeship in accordance with the requirements outlined on page 37. During this period the apprentice is required to purchase a kit of tools which amounts to several hundred dollars.

In a typical training program, the apprentice will learn from the more experienced workers how to care for and use the hand and bench tools, power tools and shop equipment which have been mentioned and is taught general work such as laying-out, cutting, folding, shaping, bending, punching, and welding and soldering. Related classroom studies include shop mathematics (with some

Photo: N.F.B. 82779

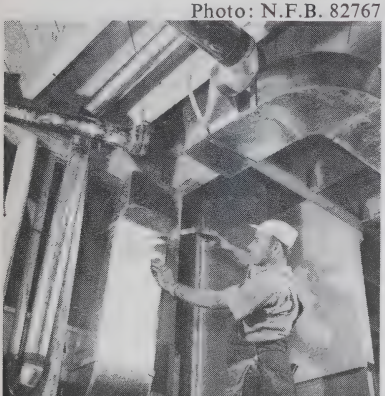
Apprentices are taught how to lay out a job in the Montreal Building Trades Training Centre.

Photo: N.F.B. 82775



Bench forming, using an anvil, must also be learned.

Photo: N.F.B. 82767

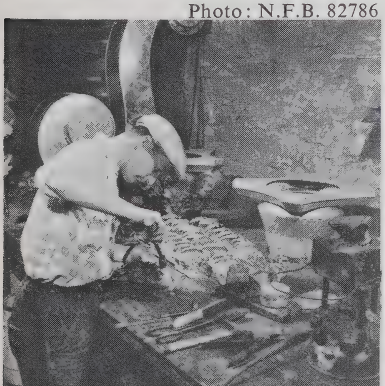


Installation of duct work to heat this new building is one phase of sheet-metal working.

Photo: N.F.B. 82745

Another phase is the repair of ducting on a composition roof.

Photo: N.F.B. 82786



Soldering pieces of sheet metal to form floral designs is intricate work.

Photo: N.F.B. 82783

The sheet-metal worker add the final touches to the chapitre which will be mounted on a column of St. James Cathedral, Montreal, P.Q.

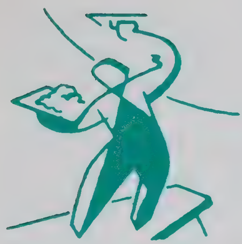
geometry), drafting, blue-print reading and the elements of metallurgy. In addition, he learns national and local building codes and safety regulations and also the relationship between the sheet-metal work and other building crafts.

Sheet-metal workers meet a variety of conditions on the construction site, and may be either indoors or out. They may work in awkward or small places when installing air-conditioning systems or be high above the ground when installing drain gutters or wall sidings. A good physical condition is necessary since there is much bending, stooping, reaching and lifting. Other sheet-metal workers engaged primarily in prefabrication will be indoors in sheet-metal shops which are well-lighted and heated.

There are few occupational hazards except the risk of cuts and burns from the equipment they use and those associated with working from ladders.

Fully-qualified sheet-metal workers offset seasonal or other slack periods in the construction industry by transferring their skills from the construction site to the sheet-metal shop or may move into metal-manufacturing plants.

Advancement is possible to foreman to the sheet-metal contractor or to superintendent on a large construction site. Others may go into business for themselves although this requires considerable financial resources for stock and equipment together with a sound knowledge of business principles.



Plasterers and Lathers

Plasterers, as the name indicates, apply wet coats of plastering materials to the interior and exterior walls and ceilings of buildings to provide plain and ornamental surfaces which are fire-resistant and can later be painted or decorated.

The first stage in interior plastering is the preparation of the walls and ceiling. Brickwork and concrete are usually left rough to form a key for the plaster but smooth surfaces are covered with wooden or gypsum lathing or metal mesh. Two or three successive coats of plaster are usually required and consist of various combinations of sand, lime, cement and plaster of paris which are mixed in small quantities by the plasterers' helpers. Scaffolding and trestles may also be erected by the helpers.

After the lathing has been nailed or stapled in position, the plasterer loads up a "hawk"—a small board with a handle—and applies small dabs or "dots" of plaster with a trowel to the top and bottom of the walls. The dots are measured with a plumbline and adjusted until they are perfectly upright and represent the final thickness of the plaster to be applied. Between these dots, strips of plaster or "screeds" are laid with a trowel and smoothed with a long, straight board or "darby". Positioning of the dots and laying the screeds are extremely important since any errors would result in an irregular surface. Preparatory work for ceilings is similar except that a straight edge and spirit level are used instead of a plumbline.

An even coat of rendering or brown plaster is then applied in the areas between the screeds and this is scratched to provide a firm foundation for the succeeding coats of plaster. The final coat is a thin mixture of lime, plaster and water which may be smoothed with a damp trowel or textured in stipple, swirl or other decorative patterns with wire brushes, metal combs and similar specially designed tools.

Over a number of years, the craft of plastering has been divided into a number of branches: lathing may be done by plasterers

but on large-scale projects is more likely to be the work of specialists—the *lathers*. Similarly, concrete work may be laid by cement finishers and outside plaster applied by *stucco workers*.

Many new techniques also have been introduced and plastering may be done by simpler methods than those described so far. Lathing and a number of coats of plaster have been eliminated to a large extent by the use of fibre board or plaster board (a sandwich of plaster between sheets of paper). The plasterer cuts the board with a knife, nails the sections to wooden joists in the walls and ceiling, and covers the joints with fabric tape. To complete the work, only a final coat of plaster is necessary and this, instead of being applied with a trowel, may be sprayed on with plastering guns.

For most walls and ceilings, plain plastering is all that is required. However, plasterers may make and install ornamental panels and decorative mouldings in offices, stores, theatres and other buildings. Typical of this work are the cornices which can be seen at the tops of walls where they meet the ceiling.

To make a cornice or similar shape, the plasterer first traces the cross-sections indicated on the architectural drawing onto thin sheets of metal. These he cuts with hand shears and mounts or "horses up" on wooden frames. On the walls and ceiling, the main location points for the various sections of the cornice are marked and pieces of wood are nailed to act as guide lines. The marking out may include circular or elliptical lines for which trammels and rules are used and a knowledge of geometry is required. Plaster is then applied where indicated by the marking and is pressed into shape with the horsing moulds.

Often cornices or other shapes are made in the plastering shop and are supplied ready for installation. The same careful marking out is necessary and the pre-cast shapes are secured in position with plaster or are nailed and screwed to wooden framework in the walls. To complete the work, plaster is added and smoothed until the shapes blend in with the contours of the walls.

As previously mentioned, decorative panels and ornamental mouldings are often made in the plastering shop and, although this is a comparatively small branch of the craft, it may appeal to those with artistic talents and who are capable of neat, accurate work. Decorative shapes are made in two stages: plainer and geometrical shapes are made in sections on a bench using horsing moulds or cast in sections in jelly moulds; enrichments such as scrolls, banners, acanthus leaves and the lamb's tongue are then added to the plainer sections. Complex decorations may first be modelled in clay by specialist *modellers* and, from the model, the plasterer will make jelly moulds and castings.

The exterior of buildings may be covered with finishing material known as stucco and this is either the work of plasterers or of specialists known as *stucco masons* or *stucco plasterers*. Their work is similar to that done inside the buildings except that a high proportion of cement is used for weatherproofing. Wire mesh normally provides the base on which several coats of plastering materials are applied. The walls are smoothed with angle floats and trowels or may be worked with brushes or tools of the mason's own design into decorative patterns. Alternatively, small stones may be flung against the wall while the plaster is still wet. Included in the work of the stucco mason is the making of cornices, moulded ledges and other ornamental shapes.

Entry into the plastering craft is through apprenticeship (see page 37). During the training period, the apprentice will learn how to mix materials; the preparation of surfaces including levelling, plumbing, lining up and squaring; use of power tools; and how to make decorative and other moulds. Related classroom studies will include mathematics, geometry and drawing, the techniques of moulding and an introduction to power equipment.

While plastering is not considered the most strenuous craft on the construction site, good health and stamina are required since bending, stooping or reaching to ceilings is hard on the back and wrists. Manual dexterity—the ability to work with the hands—is a prime requisite as is a good eye for straight lines and proportions.

Plasterers encounter the usual hazards associated with working from scaffolding and trestles. Indoor work is dusty and at all times damp. On all but the largest projects, the amount of plastering at any site rarely lasts more than several weeks and, in consequence, considerable movement from site to site is necessary. In common with other work at the construction site, plastering is seasonal with some slack periods during the winter and considerable overtime during the periods of greatest construction activity during the summer.

Opportunities for advancement are limited to the few openings available as foremen in the larger contracting firms. It is possible to act as a subcontractor for plastering work and from these beginnings to open one's own plastering business.

The plastering team "rough-in" the walls and ceiling of a new home.
Photo: N.F.B. f/s

Tile Setters and Terrazzo Workers

The exterior and interior walls of buildings, floors and other surfaces are covered with tile of burned clay, asphalt, composition, plastic and similar materials by a *tile setter.* Tiling provides an attractive and decorative surface which is weatherproof, hard wearing and easy to keep clean.

Floors may also be covered with marble chips set in cement by a specialist known as a *terrazzo worker.* Closely related to these occupations are *marble setters* who affix panels of marble to walls or other surfaces, and *cement finishers* who lay plain, ornamental or specialty floors of cement.

In any tiling job, existing surfaces have to be checked with a spirit level, straight edge and rule, and any damage or discrepancies rectified with plaster and cement.

If both walls and floor are to be tiled, the tile setter first starts on the walls by marking out a line known as the "datum line" from which all measurements will be taken. From the datum line, the position of the bottom row of tiles is marked on the wall and any special arrangements laid out. The techniques of laying tiles of various composition is similar but different kinds of adhesive are used.

Clay tiles are soaked in water, allowed to drain and cement which will act as the adhesive is spread over the back of the tile with a trowel. Starting with the bottom row, the tiles are pressed on the walls following the markings previously made and are tapped firmly into position with the handle of the trowel. Some tiles have to be cut to irregular shapes to fit corners or around pipe and this is done with chisels, hammers and pincers. Joints between the tiles are filled with thin cement and, later, the surfaces are washed and cleaned.

The walls of buildings may be covered with marble panels, structural glass or panels of terrazzo. This is similar to tiling except that the panels are of large size and little fabrication is done since polishing and cutting are completed before delivery to

the construction site. The panels are affixed with special plaster and cement mixtures or secured with bolts; in the latter case, drilling may be done at the site.

In floor tiling, instead of a datum line, a strip of wood is fixed to the subfloor to mark the edge of the first row of tiles and to indicate the height of the finished floor. A coating of adhesive is spread on the floor to a width of two or three feet, is levelled and, on this, the tiles are pressed into position until they are flat. The strip of wood is then moved to the next section and further tiles are laid until the floor is completed. As in wall tiling, the joints are later filled.

Using similar techniques, floors are laid with mosaic which consists of very small tiles supplied in pre-arranged patterns and mounted on fabric mesh or stiff sheets of paper. Tiles or terrazzo may also be supplied on a backing in pre-arranged patterns ready for laying, thus considerably reducing the amount of laying out required of the craftsmen.

Photo: N.F.B.


Setting tiles in plain (left) or decorative patterns (right) calls for a steady hand and an eye for colour blending.

In terrazzo laying, flooring paper is often laid over the subfloor. The terrazzo worker places metal strips where there is to be a joint or change of colour and moulds where there is to be lettering or a decorative pattern. Next a fairly dry layer of concrete is spread over the paper and is levelled and smoothed with a straight edge and trowel. The terrazzo worker then applies a mixture of sand, cement and marble particles following the pre-arranged colour patterns and designs. Before this mixture has time to set, marble chippings are scattered over the soft surface. A few days later, the surface is finished with electrically powered machines equipped with grinding and polishing discs.

The craftsmen are assisted by apprentices and by helpers who keep them supplied with materials, erect scaffolding, clean the tiled surfaces or operate polishing machines.

Apprenticeship is the recommended route to any of these crafts and is a requirement in the provinces of Alberta and Quebec (see page 37).

These occupations are not considered strenuous although prolonged kneeling is required when floor tiling and there is a fair amount of reaching to be done. A good eye for straight lines and proportions, a good sense of colour blending and a steady hand are also necessary.

Although tile setting and related work tends to be concentrated during the summer months which is the period of greatest activity in new construction projects, the craftsmen are less affected by extremes of weather than other construction workers since most of the tiling is indoors. In addition, the tile setters turn to indoor renovation and improvement work during periods of inactivity in new construction.

The amount of tiling at any construction site is limited and there is frequent movement from one site to the next. Occupational hazards are few other than those when working from scaffolding.

There are few opportunities for advancement, which is probably limited to opening one's own business. The largest companies may employ a foreman tiler.

Concrete and Cement Finishers

Extensive use is made of concrete—a mixture of cement and broken stone or "aggregate"—for construction purposes. It is the job of *concrete finishers* to work the exposed concrete surfaces such as floors of buildings, or curbs, sidewalks and surfaces of streets and highways so that they are relatively smooth and weatherproof. Alternatively, *cement finishers* may cover or "finish" the concrete surfaces with cement to rectify defects or to produce special shapes. These workers are also known by general titles such as *cement-and-concrete masons* or *finishers;* others specialize, particularly in highway projects, and are known as *curb builders, joint setters, concrete pointers, float finishers* and so on from the work they do.

In all but the smallest projects, concrete is now laid by machines and the surfaces finished by *tamping machine operators, vibrator operators* and operators of similar machines, supplementary hand operations may, however, be required. Cement finishers may rectify defects by filling depressions and smoothing the surfaces with a board or straight edge long enough to extend across the poured concrete mixture. Trowels, wood floats which are like a small mortar board, and other hand tools may be used to make grade slopes, and circular or other special shapes such as those required around drains and manholes.

Small areas such as driveways and sidewalks or the basement floor are often made by hand. In building a driveway, straight lengths of wood are set for the desired slope and depth of concrete and are aligned with spirit levels and steel rules. Concrete, which is usually delivered ready mixed to the site, is poured under the direction of the concrete finisher between the pieces of wood and is then levelled by the finisher who pulls a long piece of wood or "screed" over the surface. Final finishing is delayed until the concrete has hardened sufficiently to prevent small stones from working to the surface. At this stage, the finisher works the surface with trowels and other hand tools. Some concrete surfaces are left rough and the finisher applies coatings of cement, hot asphalt or other weather-resistant materials all of which are levelled and may be smoothed or patterned with brushes to provide non-slip surfaces.

The foregoing occupations are learned on the job except in the province of Quebec where a two-year appprenticeship is required (see page 37). Elsewhere, cement and concrete workers obtain jobs as helpers during which time they acquire knowledge and skills from the more experienced workers. Those who demonstrate an interest and perform their work well are then promoted to concrete and cement finishers. During the learning period, they must acquire a knowledge of materials such as the characteristics of concrete mixtures and the effects of cold or heat on their setting characteristics. They must learn how to handle power-operated equipment and hand tools, and be able to use measuring equipment such as rules and steel tapes and be able to calculate quantities of material.

Cement finishers are required to work outdoors in areas which may be muddy or dirty. Other cement work, such as floor finishing, is indoors where the workers are protected from the weather. A good physical condition is required since there is considerable standing, kneeling and sustained physical effort. The work is seasonal since concrete cannot be laid outdoors at very low temperatures; slow periods are experienced during winter months and considerable overtime during the summer.

On highway construction, much travelling is involved and the cement workers live for lengthy periods at the construction site away from home.

A few openings are available as foremen on construction sites. Other concrete workers may operate their own business and do small jobs locally such as floors, driveways, house steps and similar residential work.

Painters and Decorators

The *painter* is a craftsman who has the necessary skills, knowledge and experience to apply coatings to the interior and exterior of new or existing structures for the purpose of preservation, decoration and maintenance.

Before the work is started, the painter may have to estimate materials, time and other costs and supply a quotation to the potential customer. In the larger establishments, however, this may be the work of estimators or clerical staff.

In any new painting and decorating job, existing surfaces are prepared and scaffolding may be erected. Rough areas are smoothed either by hand sanding or with a hand-held power sander; nail holes, cracks and joints are filled with plaster or other materials and minor repairs such as patching plaster or replacing rotted timbers have to be carried out; finally, the areas are brushed or washed to remove dirt and dust. In maintenance work, old paint may be burned off with a blowtorch or removed with paint-stripping liquids or wallpaper removed by steaming.

Scaffolding ranging from simple trestles to bosun's chairs and swing equipment is installed as required by the height of the surface to be decorated. Installation of this equipment is rigidly controlled by municipal and provincial safety codes and the painter must know the types of scaffolding specified for a particular situation, methods of support, possible defects and other safety features.

After the surfaces have been prepared with various priming coats, materials such as calcamine, paint, enamels and varnishes are applied with a brush, paint roller or spray gun. Part of the skill of the painter lies in the knowledge of the different materials and techniques to be used on wood, masonry, metal or other surfaces: plaster and fibre board, for example, require filling; new cement must be sealed; knots in woodwork must be treated; and steelwork must be coated to prevent rust.

Skills are required to produce attractive and suitable colour schemes and although much of the paint is now supplied ready mixed, the painter is required to mix paints for a special purpose, must know of their suitability, drying and handling qualities and must be able to match or adapt colours for a particular job. In addition, some painters are required to undertake lettering and decorative designs, either freehand or by stencil, and again artistic skills are required together with a steady hand.

Painters may specialize in one technique such as spray painting, in one type of work such as painting structural steelwork or may undertake renovation work only. In many homes and businesses, increasing use is being made of wallpaper, wood panelling and other materials such as plastics which provide work for the all-round painter and decorator.

In wallpapering, existing paint or paper is removed and the walls are "sized" with a preparation designed to prevent absorption of the adhesive applied to the new wallpaper.

Wallpaper is supplied in rolls of standard width which are cut to the required length with scissors. The decorator may mix and apply adhesive evenly over the back of the paper or the adhesive may already be in position. Next, he folds the paper into convenient lengths, removes the edges with a rotary cutter and places the top edge in position on the wall. After ensuring that the edges of the paper match the preceding length, he smoothes the paper in position with a brush. Next the top and bottom edges are cut and, finally, the overlapping edges are smoothed with a small roller.

Painting and decorating are learned through apprenticeship the requirements for which are given on page 37.

Any physical handicaps which would affect climbing are a restriction since painting is done from ladders and scaffolding. The painter is required to stand for long periods, have strong wrists and be able to handle heavy ladders and carry cans of paint. Excellent colour vision is essential. To ensure good customer relations, a pleasant, courteous manner, cleanliness and the ability to get along with people are necessary.

Advancement after reaching journeyman status depends on experience and ability; a limited number of positions are open as foremen and supervisors. Another possibility is to start a painting and decorating business since the amount of initial capital required for materials and equipment is within the reach of most journeymen.

Working conditions vary considerably and may be indoors or out. An attempt is made to confine outdoor work to periods of good weather and indoor work to the winter months; some slackening of work can be expected in winter. There are occupational hazards such as those associated with working from ladders and there is also the smell of paint to contend with.

Operating Engineers (Construction Machinery Operators)

A wide range of power-driven equipment is used on all construction sites in such work as excavating, drilling, lifting, hoisting and material handling, site grading and levelling and material mixing. This equipment is operated and maintained by workers who are identified by the type of equipment on which they are employed, i.e., *tower-crane operator, power-shovel operator, driller, pile driver, bulldozer operator, concrete mixer, hoisting engineer* or *crane operator.*

The main task of all operating engineers is to manipulate control levers, footpedals and control switches for which the prime requisites are good eye-hand-foot co-ordination together with sound judgment of loads and distances. The controls range from the relatively few needed to operate a bulldozer to the many levers and other controls used by a crane operator to raise or lower the crane boom, vary the length of the loadline, and to rotate or otherwise move the crane. From this it will be appreciated that each piece of equipment will require different operating techniques and these are learned by practical experience. To obtain reasonably continuous employment it is necessary to acquire skills and be able to operate several of the various machines used on the construction site.

In addition to operating duties, the workers lubricate the machines, effect minor repairs to keep the machine operating and, where necessary, may replace certain parts. Major repairs and overhaul are, however, usually undertaken by heavy-duty mechanics or repairmen who are described in MECHANICAL REPAIR OCCUPATIONS in this series (see inside front cover).

Formal apprenticeship schemes are not yet available for these occupations (except in the province of Quebec where a course of 144 hours is provided for shovel, crane or tractor operators) and new entrants start by obtaining employment as helpers around the construction site. While in this employment they gain a knowledge of the equipment, learn how to keep it in running order and may help with repairs. Those who demonstrate an interest and perform their work well may be given a chance to learn operation from the more experienced workers.

Courses given in municipal or provincial trade schools in such subjects as heavy-duty mechanics or automotive servicing would provide some rudiments of the trade. A few privately operated schools offer courses of three- to six-weeks duration in heavy equipment operation and maintenance; fees required are approximately $600. Manufacturers and distributors of power equipment may also provide instruction to workers employed by purchasers of their equipment.

In the provinces of Nova Scotia and Ontario, certain types of equipment may only be operated by licenced personnel who have qualified by written examination.

Equipment operation is active work undertaken outdoors on the construction site and is considered strenuous. Constant movement on machines such as bulldozers shakes and jolts the operator and a sound physical condition is necessary. The work is seasonal and tends to be concentrated during the summer months. For workers such as those employed on highway construction, considerable travelling is involved and the worker may be required to live in a construction camp at the site.

Advancement is from the operation of the simpler types of equipment to those which are more complex and for which higher rates

The pick and shovel of a bygone era have been replaced by power equipment in the hands of these skilled operators. Excavation operator and truck driver (top); sheep-foot roller operator compresses the rough surface (middle left); grader operators level the surface (middle right); "black topping" is another machine operation (bottom).

Photos: FEDERAL DEPARTMENT OF PUBLIC WORKS

of pay are given. Foremen and a few supervisors are also employed on the larger construction projects; in addition to operating skills, these positions require a knowledge of marking out, use of levelling instruments such as the dumpy level, and the ability to read drawings and other instructions.

ORGANIZATIONS

About one-third of the non-supervisory workers in the construction industry are covered by union agreements and are represented by affiliates of national or international unions. Other unions are also active on a craft or directly chartered local basis. Selected as typical from the 1963 edition of ORGANIZATIONS IN CANADA (published annually by the federal Department of Labour) are the following:

Bricklayers, Masons and Plasterers' International Union of America—(AFL-CIO/CLC)

United Brotherhood of Carpenters and Joiners of America—(AFL-CIO/CLC)

International Brotherhood of Electrical Workers—(AFL-CIO/CLC)

International Hod Carriers and Common Laborers' Union of America—(AFL-CIO/CLC)

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada—(AFL-CIO/CLC)

Building Workers' Federation (CNTU)

International Union of Operating Engineers—(AFL-CIO)

Sheet-Metal Workers' International Association — (AFL-CIO/CLC)

International Association of Bridge, Structural and Ornamental Iron Workers—(AFL-CIO/CLC)

Brotherhood of Painters, Decorators and Paperhangers of America—(AFL-CIO/CLC)

Operative Plasterers' and Cement Masons' International Association of the United States and Canada — (AFL-CIO/CLC)

EMPLOYMENT OUTLOOK

During the 1960's, employment in the construction industry should show a steady upward trend and it is expected that job opportunities will increase at an average rate of approximately three per cent each year; this rate of growth is slightly above that of the labour force as a whole. However, fluctuations will occur and not all sectors which make up the industry will grow at the same rate.

Residential building which is the sector most sensitive to changes in the economy and can expand or contract rapidly, has shown little growth over the past few years; 1964 has been described as a transitional year prefacing larger expenditure in the years ahead. An upward cycle is now indicated: it will be necessary to provide dwellings for the large numbers of children who were born in the immediate post-war years and who will reach marriageable age between 1967 and 1972; attention is being given to urban renewal or the replacement of older dwellings and to the problems of accommodation for the aged, the low-income families and many others.

In the industrial buildings sector which embraces the erection of new factories and processing plants, there is evidence of the beginning of another cycle of spending and some slight increases in employment are indicated.

The upsurge of welfare services and the requirements for additional educational facilities is leading to the construction of more hospitals and clinics as well as university buildings, technical and academic institutions, and elementary, vocational and high schools.

Based on these indications of increased spending activity, employment opportunities in building construction are expected to increase at or slightly below the predicted average rate of three per cent annually. Employment for architects and related technical staff are expected to exceed this rate with some shortages indicated from time to time for highly competent supervisory workers. Opportunities for bricklayers, carpenters and related building craftsmen are expected to be slightly higher than the average growth rate. Better than average increases in volume of work are predicted for electricians, plumbers and other craftsmen concerned

with heating and air-conditioning systems or the other amenities being incorporated into modern buildings.

Increases in the amount of prefabrication of parts such as roof trusses are not expected to have a significant effect on the craftsmen since they can transfer their skills from the construction site to the prefabricating plants but will slightly increase the number of hoist, crane and other operators required to place prefabricated parts into position. In addition, employment for machine operators such as jointers, planers and shapers back at the fabricating plant should increase. Further introduction of mechanical or powered equipment will lead to some reduction in the numbers of unskilled or semi-skilled workers at building construction sites although because of the nature of the residential building sector—relatively frequent moving from one site to the next, small sites and lack of standardization—there are limits, at the present time, to the amount of mechanization which can be introduced.

Engineering construction represents about 35 to 40 per cent of the total construction expected during the 1960's and because of the long-term nature of many projects (some from three to five years duration) employment is not subject to fluctuations. Considerable development is indicated and the volume of expenditure in 1964 could reach the $8,000 million mark for the first time in Canada's history. This expenditure could spark off the beginning of long-term increases in employment with a steeper climb beginning in 1967 and continuing well into the 1970's. Projects about to start or already underway include Columbia River water project, the Peace River hydro-dam in British Columbia (each estimated cost $800 millions), South Saskatchewan Dam ($8 millions), Red River Floodway, Manitoba ($63.2 millions), the World's Fair, Montreal ($75 millions) and the Hamilton Falls hydro project in Labrador ($700 millions). To this must be added significant increases expected in the expenditures on roads, streets and highways at all levels of government—municipal, provincial and federal—and on sewage plants, waterworks, power-generating stations and gas and oil facilities.

Based on the anticipated expenditures in engineering construction, employment opportunities should be higher than the average predicted for the construction industry as a whole. Prospects for civil engineers, highly competent supervisory staff and related

technical workers are good and shortages are likely to occur from time to time. Employment opportunities will be good for operating engineers and other operators of earth-moving, excavating and similar heavy equipment, carpenters, structural steel and concrete workers and it is in these occupations where the greatest increases are expected to be made.

SEEKING EMPLOYMENT

Before seeking employment, students, while still in school, should discuss their future plans with the school guidance counsellors. They are in a position to supply much more detailed information than can be included in a booklet of this size, especially on such subjects as the entry requirements into schools of architecture, engineering colleges and institutes of technology. They can also supply details of trade and vocational schools or other pre-employment training courses which may be available in a particular area. This is a continuing service and information can be obtained from the guidance counsellors or the placement officers of the National Employment Service who are located in post-high school institutions.

Young people seeking their first jobs and older workers wishing to change occupations, can register with the local office of the National Employment Service where they will be given every assistance in locating suitable apprenticeships or other employment. These offices can also supply much additional information such as employment prospects and future outlook, working conditions and pay scales in local areas. To obtain a construction apprenticeship, an applicant, in addition to contacting the National Employment Service, can pursue one of the following methods: consult the provincial Director of Apprenticeship (addresses are listed on page 41); locate a contractor who is willing to hire him as an apprentice; contact a local union and request to have his name placed on their apprentices' training list; present his name to a Joint Apprenticeship Committee which indentures each apprentice and is responsible for his employment and training; or check want ads in daily and weekly newspapers. Job seekers can also apply directly to likely employers without reference to a particular vacancy and employment leads can be obtained from friends and relations already working in the industry.

EARNINGS

The salaries paid to design, technical and supervisory staff vary with the degree of responsibility and with the specific function within the industry. Below are salary ranges in government service for selected occupations during 1964.

Grade	*Architects and Civil Engineers*	*Land Surveyors*	*Draftsmen*
1.	\$ 4,860 - \$ 6,060	\$6,510 - \$7,470	\$2,820 - \$3,780
2.	6,180 - 7,320	7,200 - 8,220	3,930 - 4,980
3.	7,560 - 8,620	-	5,160 - 5,880
4.	8,520 - 9,600	-	6,390 - 6,930
5.	9,500 - 10,700	-	6,750 - 7,410
6.	10,900 - 12,300	-	7,680 - 8,700
7.	12,300 - 13,800	-	-

In general, salaries paid in occupations not given above such as estimators, specification writers and supervisors range from a starting rate of \$4,000 rising to \$8,000 per year for those with several years of experience; a few cases have been reported of workers in this group receiving salaries in excess of \$10,000 per year.

Pay scales for craftsmen and related workers are tabulated on the following tables which give approximate hourly rates prevailing in the industry on a Canada-average basis and should be used for general guidance purposes only. Pay scales frequently change, are subject to geographical differences and vary with the branch of the industry. The reader should refer to the National Employment Service, local employers and union officials or such publications as Wage Rates, Salaries and Hours of Labour in Canada *published by the federal Department of Labour annually, for the current rates in a particular geographic region.*

LOCALITY	PREVAILING WAGE RATE PER HOUR												
	Carpenter and Joiner	Bricklayer and Stonemason	Roofer (built-up)	Electrician	Plumber and Steamfitter	Sheet-metal Worker	Plasterer	Lather (wood, wire, metal)	Tile Setter & Marble Setter	Terrazzo Layer	Cement Finisher	Painter and Glazier	Labourer
	$	$	$	$	$	$	$	$	$	$	$	$	$
St. John's, Nfld.	2.05	2.45	1.61	2.52	2.35	2.10	2.05	1.80	2.00	1.95	1.95	1.85	1.56
Charlottetown, P.E.I.	1.65	2.25	1.10	1.60	1.60	1.50	2.00	1.15	1.60	1.55	1.30	1.25	1.00
Halifax, N.S.	2.22	2.49	1.75	2.43	2.46	2.20	2.50	2.12	2.49	2.49	1.85	1.96	1.65
Sydney, N.S.	2.55	2.90	1.91	2.45	2.65	1.95	2.73	1.95	2.05	2.00	1.91	1.88	1.81
Moncton, N.B.	1.95	2.25	1.15	2.20	2.20	1.70	2.15	1.45	1.75	1.70	1.40	1.40	1.05
Saint John, N.B.	2.09	2.35	1.25	2.20	2.15	1.70	2.20	1.40	1.85	1.80	1.50	1.90	1.15
Chicoutimi, P.Q.	2.20	2.30	2.05	2.25	2.25	2.20	2.30	2.00	2.15	2.25	2.05	2.00	1.80
Montreal, P.Q.	2.65	2.85	2.45	2.80	2.87	2.65	2.85	2.85	2.95	2.95	2.45	2.55	2.05
Quebec, P.Q.	2.30	2.50	1.95	2.52	2.52	2.30	2.50	2.15	2.30	2.25	2.20	2.20	1.90
Sherbrooke, P.Q.	2.25	2.45	1.90	2.20	2.30	2.30	2.45	2.20	2.35	2.35	2.00	2.15	1.85
Windsor, Ont.	3.10	3.18	2.41	3.00	3.25	3.13	3.10	3.10	2.90	2.90	2.46	2.53	2.32
Hamilton, Ont.	3.38	3.25	2.35	3.60	3.65	3.35	3.13	3.15	2.70	2.70	2.45	2.60	2.10
Ottawa, Ont.	2.65	2.85	2.00	3.10	3.05	2.95	2.70	2.85	2.50	2.40	2.05	2.00	1.70
Sault Ste. Marie, Ont.	3.05	3.10	1.65	2.50	3.05	2.90	2.40	1.90	2.00	2.00	1.90	1.80	1.50
Toronto, Ont.	3.25	3.35	3.15	3.78	3.59	3.64	3.30	3.60	3.20	3.20	2.87	2.90	2.25
Brandon, Man.	2.25	2.45	1.85	2.50	2.50	2.25	2.45	2.35	2.20	2.20	1.80	2.10	1.45
Winnipeg, Man.	2.60	2.80	1.85	2.90	3.00	2.60	2.80	2.65	2.50	2.50	1.95	2.30	1.65
Regina, Sask.	2.36	2.68	1.75	2.62	2.65	2.52	2.55	2.30	2.25	2.10	1.82	2.13	1.67
Saskatoon, Sask.	2.36	2.68	1.85	2.58	2.65	2.40	2.60	2.35	2.10	2.10	1.88	2.22	1.73
Calgary, Alta.	2.85	3.10	2.05	2.95	2.85	2.85	2.90	2.70	2.90	2.90	2.25	2.35	2.05
Edmonton, Alta.	2.80	3.00	2.30	3.05	2.90	2.95	2.95	2.90	2.90	2.90	2.65	2.30	2.05
Vancouver, B.C.	3.14	3.17	2.61	3.53	3.39	3.17	3.15	3.00	3.20	3.05	3.00	2.96	2.47
Victoria, B.C.	3.00	3.10	2.39	3.35	3.14	3.10	3.10	2.80	3.20	3.05	2.53	3.00	2.28

Approximate hours per week: 40 to 48.

Source: Figures derived from minimum wage schedules established under Fair Wages and Hours of Labour legislation, March, 1964.

TABLE 2—WAGE RATES IN SELECTED OCCUPATIONS

LOCALITY	PREVAILING WAGE RATE PER HOUR											
	Structural Metal Worker (Iron Worker)				Operating Engineer (Construction Equipment Operator)							
	Structural Steel Worker (erector & welder)	Rigger (general)	Reinforcing Rodman	Ornamental Iron Erector	Grader Operator	Tractor Operator (large)	Hoist Operator (tower)	Operator (crane, dragline, shovel, pile driver)	Asphalt Tamper, Smoother and Spreader	Concrete Mixer Operator	Painter (spray)	Pipelayer, Caulker, Solderer
	$	$	$	$	$	$	$	$	$	$	$	$
St. John's, Nfld.	2.47	1.75	2.05	1.75	1.70	1.70	1.61	1.95	1.56	1.61	2.05	1.99
Charlottetown, P.E.I.	2.70	1.20	1.05	1.30	1.35	1.35	1.10	1.60	1.05	1.10	1.30	1.20
Halifax, N.S.	2.70	1.75	1.80	1.75	1.90	1.90	1.72	2.15	1.65	1.75	2.06	1.75
Sydney, N.S.	2.70	1.90	1.91	2.00	1.95	2.00	1.85	2.15	1.85	1.91	2.03	1.91
Moncton, N.B.	2.70	1.30	1.10	1.45	1.55	1.60	1.30	1.80	1.15	1.15	1.45	1.35
Saint John, N.B.	2.70	1.35	1.25	1.60	1.60	1.60	1.20	1.85	1.20	1.25	2.05	1.35
Chicoutimi, P.Q.	2.90	1.95	1.95	2.10	2.00	2.10	1.95	2.20	1.80	2.00	2.10	1.95
Montreal, P.Q.	2.90	2.30	2.35	2.60	2.48	2.48	2.30	2.75	2.05	2.40	2.65	2.15
Quebec, P.Q.	2.90	2.00	2.20	2.20	2.00	2.25	1.95	2.25	1.90	2.15	2.20	2.00
Sherbrooke, P.Q.	2.90	2.15	2.10	2.10	2.10	2.15	2.05	2.15	1.95	1.95	2.20	2.00
Windsor, Ont.	3.25	2.40	2.37	2.40	2.45	2.45	2.55	3.00	2.32	2.45	2.73	2.37
Hamilton, Ont.	3.25	2.25	2.35	2.40	2.75	2.75	2.75	3.30	2.10	2.60	2.70	2.20
Ottawa, Ont.	3.10	1.80	2.35	2.10	1.90	1.90	1.80	2.35	1.70	1.70	2.20	1.75
Sault Ste. Marie, Ont.	3.25	1.75	1.65	1.95	2.05	2.05	2.05	2.55	1.55	1.65	1.90	1.70
Toronto, Ont.	3.25	2.40	2.89	3.20	2.75	2.75	2.75	3.30	2.25	2.75	2.90	2.35
Brandon, Man.	2.90	1.65	1.70	2.80	1.70	1.70	1.65	2.00	1.50	1.65	2.20	1.50
Winnipeg, Man.	2.90	1.75	1.85	2.85	1.85	1.90	1.85	2.05	1.70	1.85	2.40	1.70
Regina, Sask.	3.00	1.85	1.80	1.80	1.80	1.80	1.70	2.00	1.67	1.75	2.33	1.75
Saskatoon, Sask.	3.00	1.90	2.00	2.00	1.85	1.85	1.78	2.15	1.73	1.78	2.47	1.80
Calgary, Alta.	2.99	2.10	2.38	2.99	2.30	2.30	2.20	2.60	2.05	2.15	2.55	2.15
Edmonton, Alta.	2.99	2.10	2.38	2.99	2.30	2.30	2.20	2.60	2.05	2.20	2.55	2.10
Vancouver, B.C.	3.37	2.57	2.96	3.37	3.26	3.26	3.13	3.47	2.52	2.62	3.21	2.62
Victoria, B.C.	3.37	2.30	2.96	3.37	3.26	3.26	3.13	3.47	2.28	2.43	3.25	2.30

Approximate hours per week: 40 to 48.

Source: Figures derived from minimum wage schedules established under Fair Wages and Hours of Labour legislation, March, 1964.

TABLE 2—WAGE RATES IN SELECTED OCCUPATIONS—Concluded

OCCUPATIONS	Canada Total		Nfld.		P.E.I.		N.S.		N.B.		Que.		Ont.		Man.		Sask.		Alta.		B.C.		Yukon & N.W.T
	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1951	1961	1961
Civil engineers (M)	7,743	11,888	84	141	26	29	343	356	248	317	2,295	3,554	2,655	4,227	383	486	254	426	577	986	878	1,326	40
" " (F)	—	29	—	—	—	—	—	1	—	—	—	5	—	21	—	—	—	—	—	1	—	1	—
Architects (M)	1,697	2,874	9	17	1	6	29	49	21	34	572	894	723	1,117	85	180	25	72	96	191	136	314	—
" (F)	43	66	—	—	—	—	—	1	1	—	9	27	21	21	1	3	4	1	4	6	3	7	—
Surveyors (M)	4,404	8,384	91	245	20	33	276	348	141	220	583	1,327	1,541	3,121	199	476	199	427	730	1,012	624	1,113	62
" (F)	21	58	2	—	—	—	2	2	—	—	3	12	9	23	—	2	—	—	4	12	1	7	—
Owners and managers (M)	22,415	35,812	156	270	53	110	635	929	430	648	5,192	8,565	10,472	14,545	1,132	1,666	677	1,456	1,723	3,642	1,945	3,928	53
" " " (F)	139	379	—	6	1	1	6	11	6	8	25	54	66	184	10	13	3	14	8	39	14	49	—
General foremen (M)	11,569	18,313	237	427	70	103	802	858	486	603	3,077	4,616	3,875	6,168	503	931	385	986	904	1,949	1,230	1,608	64
Inspectors (M)	1,617	3,887	18	63	8	24	86	122	42	92	390	998	613	1,562	119	210	48	97	114	319	179	392	8
Carpenters (M)	129,045	122,126	4,573	4,237	898	924	6,943	6,167	4,615	4,660	39,881	38,022	39,149	36,576	6,952	5,740	4,176	4,810	8,879	9,098	12,979	11,565	327
Plumbers and pipefitters (M)	29,531	37,567	501	626	123	138	1,272	1,367	664	1,024	10,049	12,424	10,926	13,282	1,114	1,550	575	1,259	1,847	2,673	2,460	3,138	86
Sheet-metal workers— construction (M)	—	7,137	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheet-metal workers— other (M)	—	9,323	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheet-metal workers—total (M)	13,299	16,460	173	180	27	21	285	449	225	269	3,139	4,711	6,159	6,679	1,042	1,092	327	530	736	1,145	1,186	1,371	13
Sheet-metal workers—total (F)	451	642	1	—	—	—	—	1	—	—	66	42	369	580	7	5	1	—	1	5	6	9	—
Structural metal workers— construction (M)	1,838	2,592	57	—	1	—	81	—	70	—	365	—	718	—	89	—	27	—	181	—	249	—	—
Electricians, wiremen and repairmen (M)	—	49,381	—	853	—	159	—	1,993	—	1,043	—	16,125	—	18,722	—	2,163	—	1,305	—	2,720	—	4,172	126
Electricians, wiremen and repairmen (F)	—	23	—	—	—	1	—	1	—	—	—	12	—	4	—	2	—	1	—	—	—	2	—
Electricians and wiremen (M)	34,992	—	544	—	110	—	1,347	—	675	—	11,962	—	13,730	—	1,456	—	623	—	1,380	—	3,165	—	—
" " " (F)	13	—	—	—	—	—	—	—	—	—	—	—	13	—	—	—	—	—	—	—	—	—	—
Painters, paperhangers and glaziers (M)	—	43,164	—	823	—	301	—	2,038	—	1,278	—	13,060	—	15,781	—	2,130	—	1,259	—	2,937	—	3,471	86
Painters, paperhangers and glaziers (F)	—	370	—	3	—	1	—	10	—	4	—	72	—	153	—	26	—	16	—	53	—	31	1
Bricklayers, stonemasons and tilesetters (M)	15,845	20,762	149	233	40	56	617	595	415	493	4,953	6,205	7,761	10,018	392	814	282	468	568	972	668	907	1
Bricklayers, stonemasons and tilesetters (F)	—	23	—	—	—	—	—	—	—	2	—	8	—	8	—	2	—	1	—	2	—	—	—
Cement and concrete finishers (M)	2,946	6,267	50	68	10	11	78	153	47	71	710	1,671	1,228	2,589	153	358	63	220	287	634	320	490	2
Plasterers and lathers (M)	9,270	10,051	27	50	20	20	182	197	66	75	2,531	2,735	3,747	4,123	564	614	240	301	933	942	960	985	9
Insulation appliers (M)	—	2,367	—	14	—	3	—	100	—	41	—	728	—	824	—	102	—	81	—	245	—	228	1
Construction workers— others (M)	7,560	13,500	107	147	15	22	177	324	124	199	1,846	4,872	2,983	4,752	371	457	160	363	643	800	1,143	1,549	15
Construction workers— others (F)	—	16	—	—	—	—	—	—	—	1	—	4	—	5	—	—	—	1	—	2	—	3	—
Stone cutters and dressers (M)	1,896	1,695	19	14	11	8	106	52	69	43	905	839	559	550	88	68	35	27	33	31	71	63	—
" " " " (F)	—	20	—	—	—	—	—	—	—	—	—	2	—	11	—	2	—	1	—	3	—	1	—
Operating engineers— (M)																							
Hoistmen, cranemen, derrickmen	13,376	15,041	310	331	27	21	723	640	324	392	2,611	2,811	5,904	7,083	366	535	54	196	354	542	2,702	2,427	63
Operators—others	—	31,794	—	987	—	240	—	1,416	—	1,253	—	6,962	—	10,531	—	1,642	—	1,715	—	3,139	—	3,673	236
Construction machinery operators	8,227	—	136	—	107	—	525	—	359	—	957	—	2,768	—	719	—	475	—	951	—	1,230	—	—
Labourers (M)	72,994	70,006	2,529	2,080	374	364	4,136	2,958	2,313	1,998	22,779	19,934	25,031	25,309	3,603	3,974	2,411	3,030	4,498	5,664	5,320	4,550	145
" (F)	169	179	2	2	—	1	4	7	3	5	55	50	68	56	11	4	6	9	11	28	9	15	2
	391,100	525,736																					

(M)—Male
(F) —Female

TABLE 3—WORKERS IN THE INDUSTRY

Acknowledgements

Grateful acknowledgement is made to the following educational authorities, professional associations, employers and trade unions for their technical advice and co-operation during the preparation of this booklet:

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Canadian Council of Professional Engineers

Engineering Institute of Canada

The Royal Architectural Institute of Canada

The Canadian Institute of Surveying

Corporation of Land Surveyors of the Province of British Columbia

Alberta Land Surveyors' Association

Saskatchewan Land Surveyors' Association

Association of Ontario Land Surveyors

Association of New Brunswick Land Surveyors

Association of Provincial Land Surveyors of Nova Scotia

Association of Newfoundland Land Surveyors

PROVINCIAL CHIEF SURVEYOR, Prince Edward Island

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Canadian Construction Association

Commonwealth Construction Company Limited

REGIONAL DIRECTOR, Western Canada
Building and Construction Trades Department, AFL-CIO

Bricklayers, Masons and Plasterers' International Union of America

Building Workers' Federation

International Union of Operating Engineers

International Brotherhood of Electrical Workers

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada

Sheet-Metal Workers' International Association

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CANADIAN OCCUPATIONS FILM STRIPS

The Department of Labour has prepared to date, the following occupational film strips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each film strip. These may be purchased from the National Film Board, Box 6100, Montreal or from any one of its regional offices.

In Colour .... Price $4.00 each
(In Canada)

Office Occupations
Careers in Engineering
Careers in Natural Science
Teacher
Electronic Computer Occupations
Careers in Library Service
Medical Laboratory Technologist

Black-and-White .... Price $2.00 each
(In Canada)

*Bricklayer and Stone-Mason
*Plumber, Pipefitter and Steamfitter
*Sheet-Metal Worker
*Careers in Construction
Machine Shop Occupations
Printing Trades
Motor Vehicle Mechanic
The Social Worker
Mining Occupations
Draughtsman
Careers in Home Economics
Careers in Meteorology

*Containing visual presentations of the essential facts in this monograph.

CAREERS IN CONSTRUCTION

Monograph No. 41

CANADIAN OCCUPATIONS

★

MEDICAL LABORATORY TECHNOLOGIST

★

MONOGRAPH 42

DEPARTMENT OF LABOUR, CANADA

All monographs in the "Canadian Occupations" series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering*, which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more.

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CANADIAN OCCUPATIONS

★

MEDICAL LABORATORY TECHNOLOGIST

MONOGRAPH 42

HON. MICHAEL STARR, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

Price: 10 cents

FOREWORD

During recent years there has been a steadily increasing demand for up-to-date information on occupations.

This demand comes from youth faced with the need of choosing an occupation and of selecting the type of training required; from parents, teachers and other counsellors; from workers shifting to other occupations; from employment service officers; from directors of personnel and union officials, and from other quarters.

This series of monographs and an accompanying series of pamphlets, the latter containing similar information in a condensed form, are attempts to meet this demand. These publications are designed for general use and cover a wide range of occupations, including professions. They indicate, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and opportunities in each.

The basic research and writing for this monograph was done by Mary E. Stuart, under the direction of William Allison and Phillip Cohen, all of the Occupational Analysis Section. The help and co-operation of the Canadian Society of Laboratory Technologists and the Department of National Health and Welfare in the preparation and validation of the material is gratefully acknowledged. Acknowledgment is also extended to the Unemployment Insurance Commission, provincial health departments and other branches of the federal Department of Labour.

Acknowledgment is also made of the assistance obtained from numerous publications on occupations prepared in Canada and in other countries.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

October 1957.


Photo: C.S.L.T.

The Technologist is the physician's fact finder.

MEDICAL LABORATORY TECHNOLOGIST

HISTORY AND IMPORTANCE

Today, a vast amount of time, thought and money goes into the study and practice of health measures, both for those who are ill and those who are well. To supply these numerous services, the doctors and nurses, so familiar in the medical field, have now been joined by many other workers with specialized training to make up the modern medical team.

Medical Laboratory Technologists, often called Laboratory Technicians, are one of the newest groups in the health field. They are the physicians' fact finders — successors to the work of Pasteur, Koch and others who first brought the techniques of modern science to the practice of medicine. Medical practice is becoming more and more dependent on the medical laboratory technologist. Indeed, this dependence has reached a point where laboratory findings form an important part of even the most routine examination and are indispensable where clinical symptoms fail to give the necessary information.

Until a relatively short time ago the medical laboratory was located in the general practitioner's back office or in an obscure corner of the hospital. Today, apart from certain routine testing, most doctors use the facilities of an outside clinical laboratory and every large hospital has a well equipped, specially designed laboratory and even the smallest has made some provision for this work to be carried on.

Paralleling the development of laboratories in hospitals has been the establishment of public health laboratories. Originally designed to deal with problems of control and prevention of epidemic diseases, their program has been expanded to encompass a broader concept of public health. Still other laboratories have been developed purely for medical research. From these originate much of the new knowledge that is eventually tested and applied in the clinical laboratories.

There has not been a corresponding growth in the number of trained personnel to staff these varied laboratories. At the present time, there is a reported shortage of medical laboratory technologists and a vigorous program to recruit and train new workers is underway.

FIELDS OF EMPLOYMENT

A large majority of medical technologists in Canada are employed by hospitals, federal and provincial public health laboratories, and the Canadian Red Cross Blood Transfusion Service. Others are employed by laboratories of clinics and doctors' offices, university and medical research centres, and pharmaceutical and biological companies. A few are also to be found in crime detection laboratories.

Laboratories concerned with the health of animals is a relatively new field of work.

LABORATORY PERSONNEL

The personnel of a large hospital laboratory usually consists of one or more pathologists, science specialists with post-graduate degrees, medical laboratory technologists, and a few unskilled helpers—usually all responsible to a senior pathologist as laboratory director.

In smaller hospitals where there is less specialization, the pathologist or consulting pathologist will have under his supervision several medical technologists with a senior technologist in charge. It is estimated, however, that there are in Canada more than a thousand small hospital laboratories where technologists work without direct supervision. In these, as well as in clinics, blood transfusion centres and doctors' offices, the technologist is responsible to one or more practising doctors.

In public health and all types of medical research laboratories, technologists work under the direction of a doctor or scientist who is specializing in a particular field.

NATURE OF THE WORK

Medical laboratory work in its broadest sense includes all those laboratory procedures that assist in the detection and control of disease, as well as the investigation and maintenance of the normal functions of the human body.

The materials with which the technologist works may be any of the body tissues; body fluids, either normal or disease-generated; foods, drugs and poisons; viruses, bacteria and larger forms of parasitic life; numerous chemical reagents and biological products.

The laboratory equipment includes a fascinating variety of both simple and complicated glassware and apparatus as well as costly precision instruments. To some extent in larger hospitals, and more particularly in public health and research laboratories, small animals are used for experimental and diagnostic work.

In all clinical laboratories—where doctors depend upon the laboratory findings to aid in making diagnoses and prescribing treatment—the tests must be performed before perishable specimens are significantly altered and in time to benefit the patient. As a result there are times when the technologist is called upon to work under pressure. Results must be dependable for a life may be at stake.

Most medical technologists come into contact with patients in their daily work but the actual technical work is done in the laboratory. In the larger centres they usually carry out more complicated procedures than in smaller ones but have less opportunity to follow through a particular case and less variety and independence in their work.

In non-clinical medical laboratories, precision and accuracy are also of utmost importance. Here, however, the relation of work to patient welfare is ultimate rather than immediate, and the work itself may be as much concerned with prevention as with the cure of illness. Consequently, the pressure of work that is characteristic of clinical laboratories is less common in this area.

Technologists make frequent use of reference manuals in the course of their work and it is necessary for them to follow technical publications in order to keep abreast of new developments. This is particularly true of those who work without supervision.

Fields of Specialization

Technologists are trained to carry out the duties involved in all areas of work. Medical knowledge and techniques, however, are expanding so rapidly that many of them are now confining their activities to a particular area. This tendency to specialize is more common in large laboratories or in ones that are engaged in a particular type of work.

The fields of specialization cannot be sharply defined. Roughly, they are biochemistry, hematology, histopathology, microbiology and serology. Each of these may constitute a department of a large hospital or laboratory.

In *biochemistry*, body fluids—blood, urine, spinal fluid, etc. —are tested to determine qualitatively and quantitatively their component chemicals. Radioisotopes are now being used as aids in diagnosis and research in many hospitals.

In clinical *hematology* the technologist makes physical rather than chemical examination of the blood. This includes red and white blood cell counts, coagulation and sedimentation tests, and hemoglobin determinations. Blood smears are made on a glass slide, stained and examined under the microscope to reveal the proportion of various types of cells and any abnormality in their shape. Bone marrow and other blood-forming tissues are similarly examined.

Histopathology is the study of the cellular structure of the body tissues in relation to disease. A portion of tissue is embedded in a substance, such as paraffin, so that it can be cut into very thin slices with a microtome and mounted on slides for examination under the

Photo: Ont. Dept. of Health

Tissue is sliced thin on the microtome.

Photo: Ottawa Civic Hospital

Planting bacteria in a culture medium.

microscope. Differential staining helps to show up cell structure and thus reveal abnormal growth.

Microbiology, for the medical technologist, is concerned with the identification of bacteria, viruses, fungi and parasites that produce disease. It is also concerned with sterile techniques, preparation of growth media, staining methods, examination of specimens under the microscope, and animal inoculations.

Serology deals with the blood serum as a means of diagnosis and the use of serological methods for identifying diseases due to viruses and parasites is increasing rapidly. Blood grouping and blood typing form a branch of serology.

PERSONAL QUALIFICATIONS

Those who are planning a career in medical technology should consider the demands of the occupation and whether or not they

have the qualities that make for success and personal satisfaction. A visit to a hospital, public health or university medical laboratory will help in making the decision.

Technologists must have integrity and be systematic, reliable and able to perform tasks that require sustained concentration. It is important to be able to work fast under pressure without sacrificing quality of workmanship.

Good eyesight and manual dexterity in handling equipment are essential. Some laboratory work, however, can be carried on by persons with certain physical handicaps.

In the areas of work where they come into contact with patients, technologists require a pleasing personality and the ability to impart confidence and alleviate nervousness. Understanding co-operation with fellow workers and with workers in other departments is important in maintaining the good relationship necessary for the laboratory to function at its best.

In smaller clinical laboratories the technologist is usually responsible for all record-keeping and cost accounting. A knowledge of typing, bookkeeping and filing is, therefore, an asset.

PREPARATION AND TRAINING

As this occupation is concerned with the knowledge of scientific principles, a sound background in scientific subjects is essential. Generally, the minimum requirement for entrance is senior matriculation or its equivalent, with credits in chemistry and either physics or biology and two credits in mathematics.

Students intending to enter medical laboratory technology as a career should consider the various ways of reaching their goal, keeping in mind the importance of a sound training program.

Many hospitals and a number of government and privately owned laboratories offer training and employment to young people. Also, most universities have science courses that are an excellent preparation for formal training. Some established programs are outlined briefly in the following sections:

Hospital Laboratory Training Program

At present there are about 90 hospital laboratories in Canada where the standard of training has been approved by the Canadian Medical Association Committee on Approval of Training Schools. Graduates are eligible to qualify as Registered Technologists. A

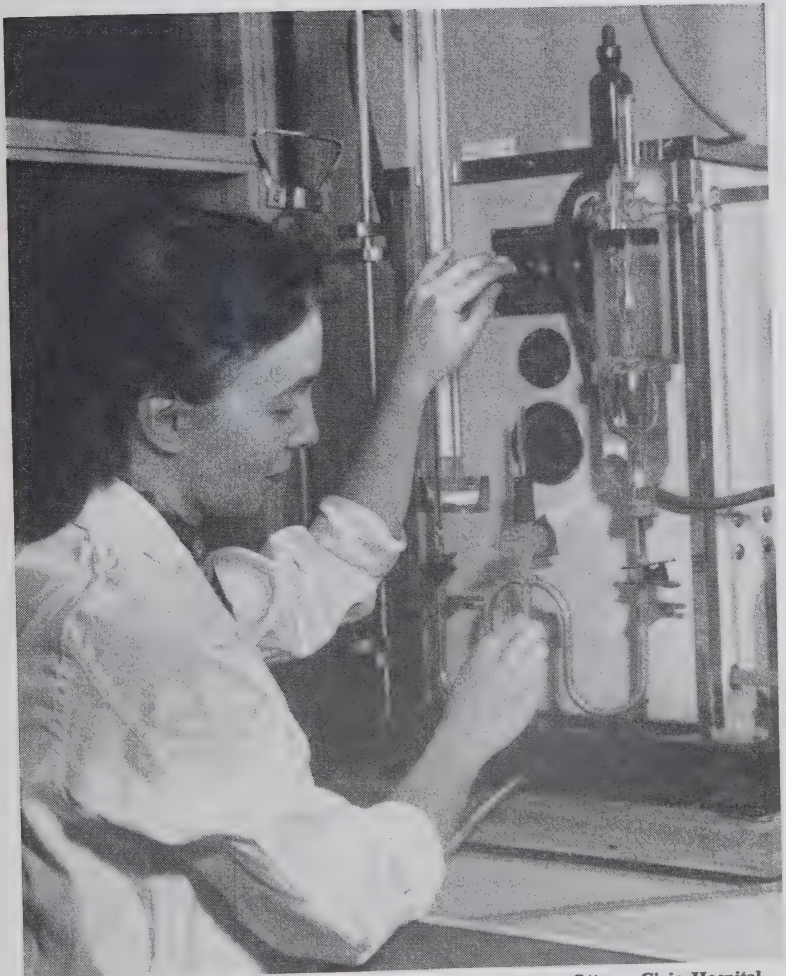

Photo: Ottawa Civic Hospital.

Does science interest you?

list of these schools is available from the Canadian Society of Laboratory Technologists, 61 Victoria Avenue North, Hamilton, Ont.

Training is essentially apprenticeship in nature, varying from 12 to 24 months. The student follows a planned program, spending specified periods of time in learning the theoretical and practical aspects of each area of work—biochemistry, hematology, histopathology, microbiology and serology. The time is divided between periods of instruction and practical work under the supervision of qualified personnel.

During the training period, students usually live out but may get some of their meals in the hospital. Some laboratories supply uniforms and pay a stipend during the training period.

Training under Provincial Public Health Programs

Medical Laboratory Technology Training

In order to meet the need for medical laboratory technologists, primarily for their public health laboratories, a number of provinces have undertaken the training of technical staff. The training is given in the provincial laboratories, the students following a program of on-the-job training supplemented by classroom work.

Bursaries, as well as other forms of assistance, are available to students on the condition that they work for a specified period in the province. In Ontario, students are paid a salary during the last five months of training. For more details, write to the provincial Director.

Particulars of Provincial Programs

Prince Edward Island

Prerequisite — Completion of the third year at Prince of Wales College or the pre-laboratory course at Saint Dunstan's University (Freshman Year), including a credit in chemistry and one other science and two in mathematics.

Time — 16 months

Information — Director, Division of Laboratories, Charlottetown, P.E.I.

Nova Scotia

Prerequisite — Grade 12 including credits in chemistry and one other science and mathematics.

Time — 16 months

Information — Director, Pathological Institute, 62 University Avenue, Halifax, N.S.

New Brunswick

Prerequisite — Senior matriculation including chemistry and one other science and mathematics.

Time — 18 months

Information — The Director, Provincial Laboratory, Castle Street, Saint John, N.B.

Ontario

Prerequisite — Senior matriculation including chemistry and one other science and two mathematics.

Time — 12 months

Information — The Director, Division of Laboratories, Department of Health, 360 Christie Street, Toronto 4, Ont.

Combined Laboratory-X-Ray Training

From time to time the Public Health Departments of Saskatchewan, Alberta, Nova Scotia and Newfoundland offer a limited combined laboratory and X-ray course designed to fulfill the staff needs of the smaller hospitals in these provinces. Students follow a course of study that will enable them to carry out limited duties in both fields in a competent manner. The course lasts six months in Saskatchewan and Alberta and eight months in Nova Scotia and Newfoundland.

A two-year course in combined laboratory and X-ray technology is offered in Manitoba.

For particulars of these courses write to the Director of Laboratories:

Department of Public Health,
Regina, Sask.

Department of Public Health,
Edmonton, Alta.

Department of Public Health,
Halifax, N.S.

Department of Health,
St. John's, Nfld.

Department of Health & Public Welfare,
Winnipeg, Man.

University Training

The increasing emphasis on a better educational background is leading more and more students to take advantage of the courses being offered at the various universities. For particulars write to the Registrar of the university of your choice.

Certificate Courses

At the present time certificate courses are being offered at:

Regina College, Regina, Sask. (2-year course)
University of Montreal, Montreal, P.Q. (1-year course)
Laval University, Quebec, P.Q. (1-year course)

These courses introduce students to the basic scientific studies that are required in their work. The university certificate is granted after one year of on-the-job training in a hospital laboratory has been completed.

Degree Courses

Three-year science degree courses are being given at most universities. This preparation is of particular value to students who plan to prepare for supervisory, teaching or research positions.

Most of the time in university is spent on various science courses, with emphasis on the areas that will be most helpful in

Photo: Sask. Gov't.

Students qualifying for certification.

medical laboratory work. Cultural courses, such as language and history, are also included. The graduate may then take one year of on-the-job training in an approved hospital laboratory in order to qualify for certification as a Registered Technologist.

REGISTERED TECHNOLOGIST CERTIFICATE

General Certificate

The only certification recognized throughout Canada is granted by the Canadian Society of Laboratory Technologists. Qualifying examinations are conducted by the C.S.L.T. in the spring and fall, at various centres, for graduates of the approved schools. At the present time, graduates of the provincial laboratory technology courses in Prince Edward Island, Nova Scotia and New Brunswick are eligible to write the qualifying examination for certification.

Applicants must be at least 18 years of age. The examination lasts for two days and consists of written and practical tests in each of the fields of study. Successful candidates receive the C.S.L.T. *General Certificate* and are entitled to use the designation "R.T. Canada" after their name.

A fee of $30 covers the cost of the examination and the first year's registration in the Society.

Specialist Certificate

After working for at least two years in a particular field—hematology, biochemistry, etc.—holders of the General Certificate or graduates of a science degree course may qualify for a *Specialist Certificate*. The one-day qualifying examination is held each spring at principal centres. In addition to the oral and written examination, each applicant must write a thesis of at least 1,000 words on a subject that has been approved by the Examining Committee.

ENTERING THE OCCUPATION

The Canadian Society of Laboratory Technologists maintains a placement service for the certified medical laboratory technologist and their *Canadian Journal of Medical Technology* carries notices of job opportunities.

Technologists may also register at the nearest office of the National Employment Service where they will be given every

possible assistance in finding suitable work. Newspapers are another source of employment information.

Sometimes an interview with the director of a laboratory or an application sent to him will lead to an appointment. Entry to positions in federal departments is through application to the Civil Service Commission, Ottawa.

EARNINGS

Salaries vary from region to region and, of course, with the technician's qualifications and experience. Generally, the earnings of experienced laboratory personnel, particularly Registered Technologists, compare favourably with the earnings of other medical service groups, such as nurses, social workers, X-ray technicians, physical therapists, etc.

According to a 1957 survey of C.S.L.T. members 0.6% received less than \$2,000 per year, 20.0% between \$2,000 and \$2,500, 41.0% between \$2,500 and \$3,000, 30.0% between \$3,000 and \$4,000 and 8.4% received above \$4,000.

Salaries in this occupation are improving. A similar survey in 1953 showed that at that time, only 44 per cent of registered technologists were earning \$2,500 or more per year and two per cent of these were earning over \$4,000. By 1957, the proportion in the \$2,500 or more group had increased to 79 per cent, and eight per cent of the workers were in the \$4,000 and over bracket. This same upward trend is expected to continue.

The university graduate who has taken post-graduate work leading to a Master's degree or a Doctorate can earn as much as those with equivalent training in other fields. For example, salaries of from \$8,000 - \$12,000 are being offered for microbiologists and biochemists in the very large hospitals.

Holiday periods with pay vary from two weeks to a month.

ADVANCEMENT

Promotion and increased remuneration will depend upon experience and willingness to assume added responsibility and supervisory duties. Specialization in a particular field of work may lead to better opportunity for advancement.

There are varying levels of supervisory positions for the qualified worker. Those who hold a university degree with post-

graduate work may advance to senior supervisory positions, such as head of a laboratory department, or they may teach in a hospital school. Some may rise to responsible positions in research work.

RELATED OCCUPATIONS

Any area of work where scientific principles and scientific equipment are used is a possible source of employment. Medical laboratory technologists may move to commercial laboratories, experimental laboratories attached to industry, and to government and university laboratories engaged in work that is not related to the medical field.

With additional training they may go into other hospital work—medicine, nursing, X-ray technology—to name only a few fields.

University-trained technologists who have a teacher's certificate may turn to the teaching of science subjects in high school or university.

Technologists who have a flair for salesmanship may become sales representatives for large drug houses and suppliers of laboratory equipment because of their familiarity with the needs of the trade.

ADVANTAGES AND DISADVANTAGES

Although as a profession medical technology is new, its very newness is an asset to those whose interest is scientific. It offers a challenge in a field of research in which the enquiring mind need feel no limit. In daily routine work there is an opportunity for service to humanity.

At the present time there are opportunities for both minimally qualified technologists and those holding a university degree. Also, it is an occupation in which women may continue to work after marriage on a full-time or part-time basis.

Unlike many occupations where there are provincial barriers, the trained person can move freely from one part of Canada to another as opportunities present themselves.

The thought of working with sputum, urine, blood and human tissue may be unpleasant to some people. Technologists, however, soon become accustomed to this, particularly when the significance of the task is understood. Medical laboratory work is not unhealthy or dangerous provided reasonable care is exercised in the handling of infectious materials, acids, alkalis, etc.

In busy periods, or when emergencies arise, technologists may be expected to work irregular hours, do shift work, and even week-end duty. This is a condition that is frequently encountered and accepted in all medical service work.

Hospital benefit schemes and retirement plans are not as well developed as in industry and government but many hospitals have or are planning such programs for their employees.

ORGANIZATIONS

Qualified medical laboratory technologists are eligible for registration in the Canadian Society of Laboratory Technologists. This national Society is active on behalf of its 1,500 members and has been one of the prime movers in the drive to establish training standards across Canada. It publishes periodic news bulletins and a quarterly journal, the *Canadian Journal of Medical Technology*. These publications keep members informed of the Society's activities and contain articles of scientific interest.

Provincial branches have been established in Prince Edward Island, New Brunswick, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. In cities where there are a number of technologists local groups meet periodically to discuss and study matters of common interest.

FUTURE PROSPECTS

The future employment outlook of medical laboratory technologists is bright. This is evident when one considers the changes that have taken, and are taking, place in the health field.

Major developments have been the growing reliance of the medical profession upon laboratory findings in diagnosis and treatment, and the public demand for such medical services. This demand has brought about an expansion of public health laboratory services and an extension of government-sponsored health programs. The tremendous growth in population in the last decade, coupled with such things as the increased use of hospitals and the various prepaid health plans, is adding to the urgent need for expanded facilities.

Medical technology is a growing science. There is still so much that is not known about disease and what can be done to combat it. Each year marks advances but the race is still on to prevent and control such major illnesses as cancer, poliomyelitis, multiple

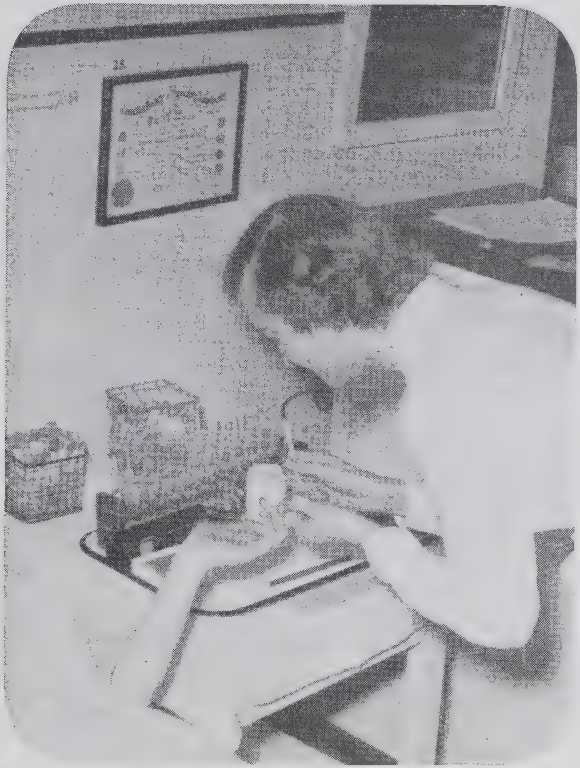

Photo: C.S.L.T.

. . . opportunity to serve humanity.

sclerosis, tuberculosis and heart disease. The application of the products of atomic research to medicine is another expanding field.

A shortage of trained laboratory technologists has been evident for some time and there is no indication of a change in the situation. This shortage has been relieved, to some extent, by the immigration of qualified workers from other countries. The number that enters the field each year from training schools, universities and other countries little more than fills the vacancies left by those leaving it through marriage and other reasons. That

leaves only a very small number available to staff new and enlarged medical laboratories.

The demand for technologists who have taken the university course is keen. The fact that they are able to train and supervise other workers makes them key persons in an organization.

Most medical laboratory technologists are women, although more and more men are recognizing the opportunities to be found in this field.

This is a demanding career but, at the same time, it offers a promising future in a growing field, opportunity to serve humanity, and a great measure of personal satisfaction.

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LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 11, 12, 13, 39 and 42 have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (Other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction
(42) Medical Laboratory Technologist

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1957

OTTAWA
EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY

CANADIAN OCCUPATIONS

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CAREERS IN METEOROLOGY

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MONOGRAPH 43

DEPARTMENT OF LABOUR, CANADA

All monographs in the "Canadian Occupations" series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering*, which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

Send remittance by cheque or money order, made payable to the Receiver General of Canada to:

The Queen's Printer,

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CANADIAN OCCUPATIONS

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CAREERS IN METEOROLOGY

MONOGRAPH 43

HON. MICHAEL STARR, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

Price: 10 cents

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. This demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

The "Canadian Occupations" series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or group of occupations, entrance and training requirements, working conditions and employment outlook.

Occupational information tends to become dated as a result of changes in economic conditions, industrial technology, wage and salary structure, etc. Revision of outdated publications is a regular feature of this series, and space is left in the last few pages of each monograph for recent changes and other local information concerning the occupation.

This series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

The present monograph was edited by William Allison, Chief of the Occupational Analysis Section. Grateful acknowledgment is extended to the Meteorological Branch of the Department of Transport for their help and co-operation in providing the basic textual material and in checking the final draft.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

February 1958

CAREERS IN METEOROLOGY

Photo: N.F.B.

Meteorologists prepare a weather forecast

HISTORY AND IMPORTANCE

There are few aspects of our day-to-day living which are not affected to some extent, if not actually determined, by the changing weather. The farmer and the fisherman, the builder and the storekeeper, the aviator and the sportsman, to mention a few, are particularly concerned with the influence of weather on their livelihood or recreation.

Meteorology, which is the study of the properties and movements of the earth's atmosphere, began some two thousand years ago, and has engaged the interest of many of the world's great thinkers, including Plato, Aristotle and Galileo.

At first meteorology consisted in observing and recording weather data as a result of man's consuming curiosity about the world he lives in. This led to the perfection of devices to measure certain characteristics of the atmosphere, such as pressure, temperature, humidity, wind velocity, and precipitation. The barometer, thermometer, hygrometer, anemometer and rain gauge are still the basic instruments of meteorology, although radio, radar and other electronic devices have expanded the scope of the modern weatherman.

It is one thing to observe and record the weather for historical purposes; it is quite another to predict with any degree of accuracy the weather for the coming week or even for the next few days. This latter problem has always intrigued mankind, and folklore abounds with quaint advice about tomorrow's weather. It was not very long ago that the farmer, the sailor, and the storekeeper each tried to be his own weatherman, or relied on the local prophet who had some uncanny skill or, perchance, had made one or more fortunate predictions.

The scientific forecasting of weather is a younger branch of meteorology. It relies not only on local observation, but also on observations taken at the same time in other localities over a wide area of the earth's surface. The weather data thus obtained must be analyzed by trained meteorologists, then translated into forecasts of the weather which may be expected to develop from these conditions. A meteorological service thus consists essentially of an army of weather observers scattered throughout the country, an efficient communications system to transmit weather data to central weather offices, and a staff of scientists capable of analyzing the data that has been collected.

The Canadian Meteorological Service

The Canadian Meteorological Service, which was established for the study of weather and climate in Canada, is a relatively young organization, yet its earliest records date back well before Confederation. When Lieutenant Riddel of the British Army read the thermometer outside a log barrack building at Fort York on Christmas morning 1839, he made the first of a series of weather observations that have been continuous since that day. Fort York, on the north shore of Lake Ontario, was a military camp near the village which grew to be the City of Toronto.

The first storm warnings and marine forecasts were prepared in 1873. From that small start, weather services for the public, industry, aviation and agriculture have grown in number and scope until today it seems there is no human activity to which weather information cannot be of help.

The greatest eras of expansion were closely linked with the rapid development of aviation, notably the expansion of Trans-Canada Airlines in the 1930's, and to an even greater extent with the demands of the Commonwealth Air Training Plan of World War II.

Today, operating under the Air Services of the Department of Transport, the Meteorological Service of Canada employs nearly 2,000 people full time, and its annual budget is about $11 million. Observations of weather are taken at 1,600 weather reporting stations scattered from the Atlantic to the Pacific and from the Arctic to the Great Lakes. This information is relayed to the 60 forecast offices by 38,000 miles of telegraph lines and hundreds of teletype machines which interconnect with other countries in a mass international exchange of weather information. Weather charts are flashed by facsimile over 14,000 miles of facsimile circuits.

The scope of MSC is much more extensive and complex than is generally realized. Everyone knows of the endless flow of weather forecasts issued daily. Not so well known are the complete flight forecasts given to aircrews before departure, the frost warnings to fruit growers, forecasts for forest fire fighters, for shippers of perishable foods, for construction work, snow clearance, sports events, marine shipping, bakeries, power companies, the Armed Forces, and a long list of others.

Other MSC Activities

A steadily developing technical and professional organization supports the direct meteorological services. An instrument laboratory designs, constructs, calibrates and repairs highly specialized weather observing equipment. A training section gives technical and professional instruction to new employees in the Service. A program of theoretical and practical research on meteorological problems provides stimulation and aids to the professional staff.

An expanding climatological division collects and processes the vast number of weather reports into tables, charts, and other forms suitable for various purposes, using modern data-processing methods and equipment.

At Meteorological Headquarters in Toronto, and at Regional Offices in Moncton, Montreal, Toronto, Winnipeg, Edmonton and Vancouver, an administrative staff co-ordinates, plans and supervises the many phases of Canada's weather service.

NATURE OF THE WORK

It is often thought that anyone who works in the Meteorological Service of Canada is a weather forecaster. The fact is that only about 15 to 20 per cent of the staff is professionally trained to do forecasting. The rest of the staff consists of clerical workers and technicians who gather and process weather data, plot weather charts, install and maintain weather instruments, transmit messages and keep records. A small but important staff of technicians and tradesmen work on the development, building, calibration and repair of weather instruments.

Technical Staff

Meteorological technician is the general title used for non-professional workers who carry out the wide range of technical duties in the Meteorological Service. The variety of their duties depends on the size and function of the station to which they are posted.

Weather observers make surface or ground level observations of local weather conditions at regular times. They code these observations into weather reports for transmission by radio or teletype, and keep climatological records as required. In taking surface weather observations — air pressure, temperature, humidity, wind velocity, precipitation, sky condition, cloud types and amounts, present weather, visibility, etc. — they use a variety of instruments. To observe upper air conditions, the usual method is to release a hydrogen-filled balloon and to track it with a theodolite (a form of mounted telescope) and then make calculations to determine upper wind speeds and direction.

On many stations, particularly in the Arctic and sub-Arctic, upper air observations are carried out by *radiosonde technicians*. They prepare and release radiosonde balloons which carry aloft instruments that measure temperature, pressure and humidity. In connection with these instruments, a tiny radio transmitter emits signals that indicate the upper atmospheric conditions. On the

ground, a technician operates a radio receiver that records the impulses. The recordings are then translated into meaningful data.

Photo: N.F.B.

Some observers are stationed in remote areas

Meteorological technicians who are employed at forecast offices may take observations and also prepare weather charts by plotting on maps the data received from other observing stations. It is on the basis of these charts that weather forecasts are made.

At a number of city weather offices the answering of public inquiries and other duties are handled by meteorological technicians whose initiative, ability and knowledge of the Service have qualified them for these positions which bring them into direct contact with the public. At times some of their duties approach those normally done at the professional level.

Some technicians are responsible for the installation of weather instruments and for maintaining them in good order. Others work in the climatological division checking reports, assisting in the processing of the thousands of reports received each month, and in providing data and advice in answer to the many inquiries for information on Canada's climate.

Meteorological information, if it is to be of any value, must be transmitted rapidly from its source to central forecast offices. Communication circuits connect an extensive system of teletype equipment, including a large number of automatic units. The teletype communications staff work in the many forecast offices, transmitting weather data and messages from circuit to circuit. The *teletype communicator* is responsible for the collection and relay of all observations, the transmission of forecasts, analyses and advisories issued by the station forecast offices, and the transmission, relay and delivery of administrative messages. Senior teletype or facsimile communicators are responsible for planning and supervising new installations, for the development of more efficient equipment, and for overall supervision to ensure that the communications network operates smoothly.

Professional Staff

University-trained *meteorologists* comprise the professional staff of the Meteorological Service. Their work lies in two broad areas—*weather forecasting and climatology* and *research and training*.

The majority of the professional staff work as *forecasters* at one of the major airports or at an RCAF station. They may be engaged in preparing public weather forecasts for press and radio stations, or special forecasts to help forest fire fighters or to facilitate transportation. In the aviation field they may prepare special reports on weather for domestic airlines, trans-oceanic airlines, the Armed Services and, finally, for private and recreational flying interests.

A few meteorologists are engaged in climatology (study of climate), in which their interest focuses on the records of past weather conditions rather than the forecasting of future weather. The enormous amount of weather information accumulated annually is tabulated and processed by modern machine methods, then analyzed to find the answers to queries and problems. The *climatologist* now works closely with the agriculturist, the forester,

the hydrologist or the industrial designer, whose problems may be more readily solved by knowing the overall climatic picture rather than by a knowledge of future weather.

There is an interesting field of work in meteorological research both in the Service and at universities. Several problems which are at present receiving considerable attention are: weather control (rainmaking and hail prevention), air pollution, the use of electronic computers in forecasting, the Arctic atmosphere at high levels and the complete energy budget of the earth and atmosphere. The research staff has been steadily growing and opportunities for development in this work are expected to increase.

A few meteorologists are engaged in the training of new professional and technical staff either in the Service or at the University of Toronto. A program designed to keep the practising professional up to date is in the process of organization and will become a major training field in the near future.

WORKING CONDITIONS

Weather information must be available around the clock every day in the year. Many of the employees therefore have operational-type duties and work on a rotating schedule through day, evening and night shifts. The forecaster, the observer, the plotter and the teletypist normally work shifts of about eight hours each. The shifts rotate, however, so that the operating employee spends at least a third of his on-duty time in normal working hours.

Many of the employees work in offices at airports, where the surroundings are interesting and pleasant. The offices have modern equipment and conveniences, including good lighting and air conditioning. Other operating employees are located at weather observing stations which extend in a network from coast to coast and, in a few cases, into the remote areas of our country. At these isolated posts, observers often find themselves cut off from the rest of the world, except for wireless contact and occasional aircraft. The Service does all it can to make surroundings comfortable and congenial at these posts. There are few hazards and, except for the outside duties of the observers, the work is entirely indoors.

Salaries and hours of duty are established by the Civil Service Commission and are subject to periodic review. Generous sick leave benefits are available and annual leave is given on the basis of three weeks per year, plus statutory holidays. Compensation is made to operating employees for work on statutory holi-

Photo: N.F.B.

Weather maps are transmitted by facsimile

days. Employees are paid semi-monthly on a yearly salary basis, and all share in a generous pension scheme on retirement.

EARNINGS

Starting salaries for professional staff are in the neighborhood of $4,500 and after six years a meteorologist, apart from opportunities for special promotion or advancement, may expect to earn more than $7,000 per year. Higher salaries are available for those who prove their capabilities in the many senior positions in the Service.

Meteorological technicians who are accepted for training may expect to start at a salary of $2,640, rising to a maximum of $3,240 in the first salary range. Top salaries for meteorological technicians go as high as $5,100.

In addition to regular salary, meteorologists and technicians receive a special clothing issue and extra allowance when posted to an isolated weather station.

PERSONAL QUALIFICATIONS

Applicants for positions in the Meteorological Service must be British subjects with five years' residence in Canada prior to making application. Good health and good eyesight (with or without correction) are necessary. The ability to transcribe accurately and neatly is required in plotting charts and preparing weather maps.

Those who expect to deal with the public and with aircrews should have tact, a pleasing personality, and the ability to explain technical information clearly and concisely.

The work entails extensive use of mathematics and physics, therefore persons intending to make a professional career in meteorology should enjoy these subjects and be able to do well in them. For some technical positions mechanical ability is an asset.

PREPARATION AND TRAINING

Technical Staff

There are no special educational requirements for meteorological technicians, other than high school graduation, preferably with good marks in mathematics and physics. Successful applicants are given training in the specific duties they have to do, either on the job or by classroom instruction at a central office. Training consists of instruction in the care and use of weather instruments, techniques of weather observing, making up and coding weather reports, and other related duties. Special courses are given in the use of radiosonde equipment.

Professional Staff

Preparation for employment as a professional meteorologist must include graduation from a recognized university, with emphasis on mathematics and physics. Proficiency in written and spoken English is a highly desirable qualification of the professional meteorologist, and a knowledge of modern languages may be useful because of the international scope of the science. Knowledge of geography, geophysics and other natural sciences gives one a

background of information to which he can relate the science of meteorology.

The Meteorological Service accepts applications for professional employment from candidates with either one of two levels of university education.

(1) University graduates with an Honours degree in Mathematics and Physics, Engineering Physics, or equivalent, may qualify immediately for a professional position in the Service. Applicants accepted are required to take the course in Meteorology at the University of Toronto leading to a Master's degree. Full salary is paid from the time training begins.

The Service provides candidates for the M.A. course with summer employment at forecast and observation offices (approximately 4 months). This training is a preparation for the M.A. course and enables the students to familiarize themselves with meteorological procedure and practices in Canada.

(2) Applicants with a general pass degree which includes sufficient courses in mathematics and physics may qualify as *meteorological officers*. Training for meteorological officers is given in Toronto and Trenton and lasts for seven months. It consists of a 4-week course in weather observations and codes, the presentation of meteorological data and elementary aviation meteorology; four months of theoretical and practical training in the duties of a professional meteorological officer on aviation forecast office duties, and an 8-week course in applied meteorology. Full salary is paid from the time the applicant reports for training.

Assistance is also provided by the Department for advancement to the Ph.D. level after taking employment with the Meteorological Service. Those with post-graduate studies in mind, therefore, have no need to forego such plans while serving as a meteorologist.

ADVANCEMENT

Opportunities for advancement are open to employees in all branches of the Service under the merit system of promotion set up by the Civil Service Commission. From shift work the forecaster, the technician and the communicator may, with increasing experience and ability, advance to supervisory, administrative and other positions involving daytime work only.

Professional employees wishing to specialize may have the opportunity to proceed to a career with a main interest in some

phase of research or activity such as cloud physics, air pollution, agriculture, forestry or the Armed Forces. From time to time positions become available to professional employees to serve on short-term commissions with the RCAF or RCN on overseas duties, providing ample chance for travel abroad.

Technicians may compete for promotion to the climatological, instrument or other sections, and for those with more adventurous spirits there are opportunities on a voluntary basis for work in the isolated and semi-isolated stations of the Arctic and northern areas. Some technicians may fill positions of senior observer with responsibility for supervising the work of observer-plotting technicians. A few technicians with considerable experience are employed as district inspectors, and are responsible for routine inspection of the various observing stations in their district. The more experienced radiosonde operators may have the opportunity of serving at the special training centre in Toronto, where new employees are trained in radiosonde observing.

The communicator may advance to supervisory duties or to the training of new staff in the operation of the various types of equipment, in coding procedures, and in communication schedules. Advancement to administrative positions in the communicator's field at the district or headquarters level is through competition.

RELATED OCCUPATIONS

In the consideration of related occupations it is somewhat difficult to draw a close analogy between the work performed in this field and that done in other fields. There is, particularly at the professional level, the common element of the scientific method, applicable to all branches of science. The emphasis on physics and mathematics (including statistics) relates work in meteorology to that in other scientific fields in which these two disciplines play a large part. This, together with the type of work performed, the academic requirements for qualification, and the application of meteorology to certain fields of work, means that the work of the meteorologist and meteorological officer is most closely related to that of the airline dispatcher, aeronautical engineer, airline pilot, navigation officer, forestry engineer, statistician, cartographer, hydrographer, research scientist, teacher of mathematics and science, and private meteorologist.*

*A few private meteorological firms, employing a small number of meteorologists, are in operation in Canada and a number of meteorologists have been employed by certain industries as meteorological advisors.

In the same way the work of the meteorological technician is related to that of air traffic controller, draughtsman, laboratory technician, research assistant, and assistant to cartographer, hydrographer or surveyor.

In communications, the work of the meteorological teletypist may resemble that of the teletype operator for press wire services. It should be noted, however, that the duties of the meteorological teletypist are considerably more complicated in that he maintains rigorous schedules, uses several types of equipment and must have considerable knowledge of the innumerable codes employed in meteorological work. Such training should be a valuable asset in numerous other occupations in the field of communications.

ADVANTAGES AND DISADVANTAGES

For those who can meet the minimum requirements and qualify in competition with others, meteorology offers excellent opportunities to train in a worthwhile career while on full salary. The qualifications for entry and advancement are exacting, particularly for professional positions, but these are challenging to the young person with the necessary capacity and interest. The sense of security associated with a permanent civil service appointment is an attractive feature.

Meteorology is a young science with many unsolved problems, presenting a fertile field for those with the curiosity and imagination to engage in original scientific research. The opportunity for a taste of living in the Far North, with the Armed Forces on a Navy carrier, at a European RCAF base, or on a Canadian weather ship, may appeal to some. The fascination of working with shop equipment, making and servicing sensitive instruments or operating electronic tabulating machines may find favour with those mechanically minded, while others may prefer positions in the challenging field of administration.

The weather observer must face the elements when making his periodic observations, and the radiosonde technician may find the making of hydrogen and the releasing of giant balloons a test of skill and patience in inclement weather. There is isolation and

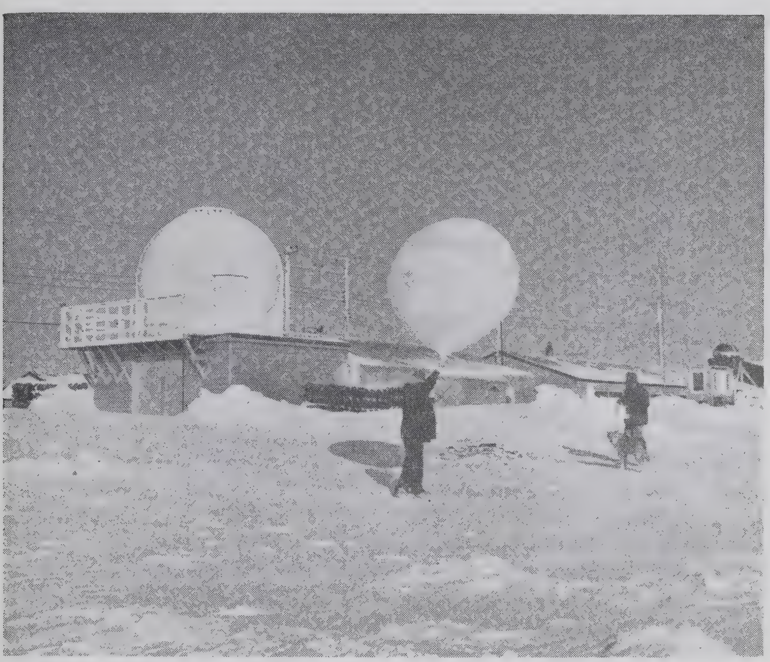

Photo: N.F.B.

Radiosonde technicians sending up a weather balloon

loneliness for those at the outposts, but special allowances, special clothing, and the pursuit of hobbies to pass the time congenially, help to compensate.

Some find that shift work is a disadvantage; others feel that it offers certain advantages over regular day work. The number of positions in research, climatology and administration, which are carried on in normal working hours, is growing steadily.

To the professional forecaster, his assistants, and all those who play a part in the operation of a complex weather service, there is gratification in knowing that they contribute to an important and necessary aspect of modern life. Advance warning of blizzards, hurricanes and flood-bringing rains means not only savings in property, but often the saving of life.

ENTERING THE FIELD

Employment in meteorology in this country is almost exclusively identified with the services provided by the Meteorological Branch of the Department of Transport, and entry is governed by regulations applicable to all Civil Service positions. Openings at both the professional and technician level occur from time to time, notices of which are posted in all Federal Government buildings. Those interested in employment in meteorology may, of course, apply without reference to any particular vacancy.

Applications for positions in the Meteorological Service of Canada should be made on an official Civil Service of Canada application form. These forms are available from all Post Offices, from the National Employment Service, branches of the Civil Service Commission in the principal cities of Canada, offices of the Meteorological Branch, and university placement offices. The completed form should be sent to the Secretary, Civil Service Commission, Ottawa, Canada. If the application is for a professional position a transcript of the courses taken at university and the marks made should be obtained from the registrar of the university and forwarded with the application.

If further information is desired the student should write to the Director of Meteorological Service, Department of Transport, 315 Bloor Street West, Toronto 5, Ontario, or, if convenient, visit the Officer in Charge of the District Forecast Offices at Vancouver, Edmonton, Winnipeg, Toronto, Montreal, Moncton, Halifax or Gander.

STAFF ORGANIZATIONS

Technical and professional staff are free to join a number of employee organizations which promote the welfare of the staff through improvement of working conditions and salary adjustment. The Professional Institute of the Civil Service represents a large number of professional staff and other staff associations look after the interests of non-professional employees.

OUTLOOK

The future of this relatively young science is alluring. The barriers of knowledge in meteorology are continually being pushed aside. Instruments probe the upper atmosphere to ever-greater

heights, unfolding its secrets and providing important information, while new theories and techniques give the meteorologist greater ability to understand and predict the ever-changing weather.

As the economic importance of weather and climate information to business and industry becomes more widely recognized, demands for service will continue to increase in number and variety. This should lead to a slow but steady expansion of the Meteorological Service of Canada which, together with the normal turnover of staff, should create a substantial number of openings for new personnel each year.

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RECOMMENDED READING

American Meteorological Society, bimonthly periodical, *Weatherwise*—The Magazine About Weather. Office of Publication, 3 Joy St., Boston 8, Mass. Canadian Issue Volume 9 Number 2, April 1956, of interest to Canadian readers.

F. H. Ludlow, R. S. Scorer, *Further Outlook*, Allan Wingate, London, 1954.

Guy Murchie, *Song of the Sky*, Houghton-Mifflin Co., Boston, 1954.

Geo. Stuart, *Storm*. Random House, 1941.

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AUDIO-VISUAL MATERIAL

The National Film Board of Canada has produced a 52-frame filmstrip entitled *Careers in Meteorology* for the Economics and Research Branch of the Department of Labour, Ottawa. The filmstrip is based on, and supplements, monograph No. 43 of the "Canadian Occupations" series. It is available through the National Film Board of Canada, Box 6100, Montreal, Quebec.

LOCAL INFORMATION

LOCAL INFORMATION

"CANADIAN OCCUPATIONS" SERIES

Monographs and Pamphlets

The monographs listed below, accompanied by pamphlets, except in the case of numbers 11, 12, 13, 39, 42 and 43, have been published to date.

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Makers
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction
(42) Medical Laboratory Technologist
(43) Careers in Meteorology

Filmstrips

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

Plumber, Pipefitter and Steamfitter
Careers in the Engineering Profession
The Social Worker
Technical Occupations in Radio and Electronics
Bricklayer and Stone-Mason
Printing Trades
Careers in Natural Science
Careers in Home Economics
Motor Vehicle Mechanic
Mining Occupations
Draughtsman
Careers in Construction
Machine Shop Occupations
Sheet-Metal Worker
Careers in Meteorology

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1958

OTTAWA
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QUEEN'S PRINTER AND CONTROLLER OF STATIONERY

Cat. No. L43-4358

CANADIAN OCCUPATIONS

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TEACHER

★

MONOGRAPH 44

DEPARTMENT OF LABOUR, CANADA

CANADIAN OCCUPATIONS MONOGRAPHS

(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
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(6) Sheet-Metal Worker
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(41) Careers in Construction
(42) Medical Laboratory Technologist
(43) Careers in Meteorology
(44) Teacher
(45) Physical and Occupational Therapist

All monographs in the CANADIAN OCCUPATIONS series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering,* which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

Send remittance by cheque or money order, made payable to the Receiver General of Canada to:

THE QUEEN'S PRINTER

Ottawa, Canada.

CANADIAN OCCUPATIONS

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TEACHER

MONOGRAPH 44

HON. MICHAEL STARR, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

PRINTED IN CANADA

45

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of this series.

This series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

This monograph was prepared by Judith Cruickshank and Helen Traynor under the direction of William Allison, Chief of the Occupational Analysis Section. Grateful acknowledgement is extended to the provincial Departments of Education, the Canadian Teachers' Federation and the Canadian Education Association for their help and co-operation in supplying information and checking the preliminary draft.

DIRECTOR,
Economics and Research Branch,
Department of Labour.

January 1959.

PREFACE

Few areas of human activity have received such public attention, in recent years, as that of education. In times of unrest and changing values, we look to the younger generation to carry on the traditions, the institutions and culture that have become our heritage. Education is the process by which this can be achieved, but only if it is carried out by an effective and energetic staff of dedicated teachers.

There is, at present, a nation-wide reappraisal of our attitude toward education, out of which much good should come. Related to this is public concern over a reported shortage of qualified teachers, over the conditions under which teachers work, the salaries they earn, and their status in the community. How much, the question is asked, can be expected of teachers in return for what they receive?

Whatever the outcome, it may safely be said that school teachers will emerge with increased stature and prestige, with better public understanding and appreciation of their role in society, and with encouragement to fulfil their chosen purpose in life.

CONTENTS

TEACHER

Photo: NFB

The teacher is concerned with education and various kinds of training. The majority of teachers are engaged in teaching children and youth in the public school system, although many teach in universities, private schools and other institutions. Teachers are professional workers who, after completing their own formal education and a further period of teacher training, become qualified to direct the studies of pupils, supervise classroom activity, and carry out a variety of other duties related to teaching.

Teaching consists in dealing constantly with people. It demands qualities of leadership, patience and understanding, and offers in return a reasonably good living and the satisfaction of playing a most important part in the growth and development of the younger generation.

HISTORY AND IMPORTANCE

Teachers comprise one of the largest single occupational groups in Canada. About 135 thousand are engaged in teaching an estimated three million, eight hundred thousand children in elementary and secondary schools. In addition, nearly six thousand professors and lecturers are engaged in teaching university students, and numerous other persons are working as teachers and instructors in evening classes, private day schools, business training schools and trade schools.

The professional teacher — that is, the person whose main occupation is teaching — dates back to very early times. The Athenian philosophers (*philos* loving + *sophia* wisdom) were among the first teachers in our early western culture, and Socrates, Plato, Aristotle and others are counted among the world's great men. The modern teacher springs from an ancient and honourable lineage.

Greek scholars, taken as slaves by the Romans, taught the children of well-to-do families in Rome. With the fall of the Roman Empire, however, the age of enlightenment in the West came to an end. As the hordes of barbarians swept over Europe, the light of learning all but flickered out and schools ceased to exist, except in isolated monasteries. The Church became the custodian of learning during the Middle Ages and consequently the clergy were associated with the spread of learning and the establishment of schools as medieval Europe entered the age of the Renaissance.

An important factor in the revival of education was the invention of printing. Books, which were traditionally associated with learning, came within reach of the masses, and this was a first step toward universal education.

State support of education and compulsory school attendance for all children within prescribed age limits are now characteristic of most countries. As teachers are directly concerned with carrying out the educational program, the future welfare of the country rests largely in their hands.

Teaching in Canada

During the early settlement of French Canada, the Roman Catholic Church established the French tradition in education that is followed today in the Province of Quebec and in most

French-speaking communities across Canada. Teaching was carried on by priests, nuns and lay persons — some were travelling teachers. In Anglo-Saxon settlements, for a brief time, education followed the British monitorial system, in which older pupils received lessons from the schoolmaster and then taught the lessons to younger children.

The generally low regard for education during the first half of the 19th century was reflected in schoolhouses staffed with teachers who, by reason of old age or other handicap, could not engage in more "productive" work. Receiving scant salaries, they would subsist by boarding here and there with parents. Later, provincial school systems were organized, and the schools were supported by taxes and were free to all. All that was required of teachers was that they show some proficiency in the basic academic subjects, and there was little formal teacher training until the latter half of the century.

Great advances have been made in education in the last fifty years. The log schoolhouses have been replaced by fine, well-equipped buildings. The average period of school attendance has risen to more than ten years. Facilities for teacher training have been greatly improved.

There has also been a change in the aim of education. Whereas the earlier system encouraged pupils to memorize a body of knowledge, with little or no real understanding, the modern school now has the objective of helping the pupil to develop his ability to understand the world in which he lives and to relate it to his own personal experience. This change has had an important effect on the work of the teacher, and calls for good organizing ability, a good grasp of the learning process and the skill to interpret the new objectives of education.

School Systems in Canada

Under the terms of the British North America Act of 1867, legislative responsibility for education was placed in the hands of the provinces. As a result, each province has developed a school system to meet its own needs. Two main types of school systems emerge: that of the French tradition which predominates in the Province of Quebec, and that of the English tradition which predominates in other provinces. Newfoundland has a system of church schools, operated by the Roman Catholic Church, the Anglican Church, the Salvation Army and other religious denomi-

nations. The federal government is responsible for education among the Indians and Eskimos, children in the Territories, and in establishments of the Armed Forces abroad.

FIELD OF WORK

The program of education and training in Canada presents a wide field into which teachers can fit according to their individual interests, abilities and qualifications. The field can be divided into three broad areas: *academic*, *vocational*, and *specialized* education.

Academic Education

Academic teaching is related to the traditional idea of education. The provincial school programs are composed generally of 12 or 13 academic grades which are divided into an *elementary* level and a *secondary* level. Professional education at the *university* level may be considered an extension of academic education with specialization in a professional field of work.

Elementary Level

The first six to eight years of education are given in elementary grades. The objective of this level is the enlargement of the child's knowledge by developing the basic skills and awakening an interest in the community and the events taking place in it. In addition to being taught reading, writing, arithmetic, spelling, and language arts, pupils are introduced to social studies, science, art, literature and music. Some schools offer instruction in industrial arts and home economics.

Elementary teachers in city schools usually have charge of one class and teach most subjects on the curriculum for that grade. In small rural schools they may teach from two to eight grades, having a small number of pupils in each grade.

In provinces where the elementary level is organized into six grades, the next three grades make up a *junior high school* level.

Pupils in elementary and junior high school levels present a wide range of growth and development, from the very young in primary grades to those in their 'teens, some of whom may be on the verge of entering the world of work. Teachers at this level have the opportunity to select the age group with which they are most successful, and to help in the development of growing personalities. There are about four times as many women teaching at this level as there are men.

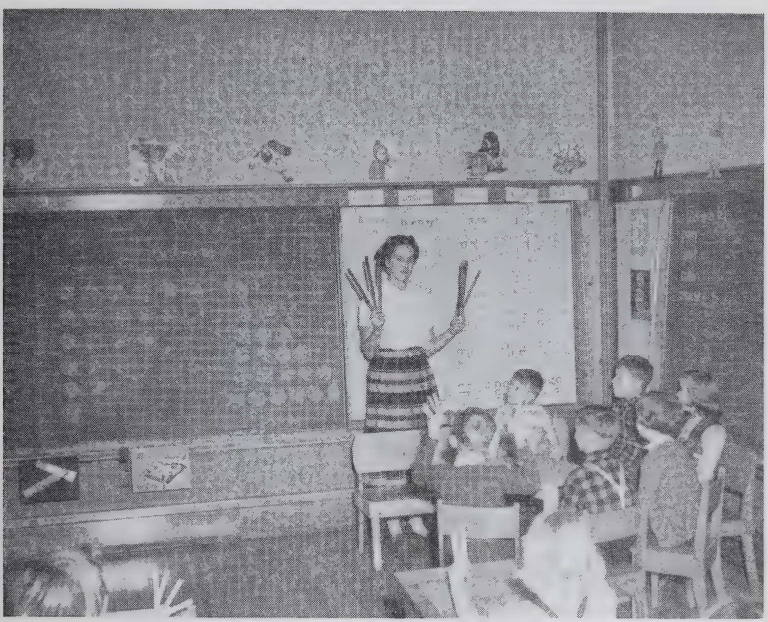

Photo: Government of New Brunswick

. . . developing the basic skills.

Secondary Level

There is greater variety in the purpose of education at the secondary or high school level, for it is at this point that students begin to direct their studies toward a vocational goal. Academic courses at the secondary level are designed to give students a well-rounded education and prepare them for university entrance or for further training in a vocation.

Students at the secondary level are older and more mature than those at the elementary level, and show more strongly the pattern of personality development. The subject matter taught is more advanced, and secondary school teachers usually teach the subjects on which they concentrated in university, thus offering the students the benefit of an extensive background in a specific field. Male teachers predominate in number at the secondary level.

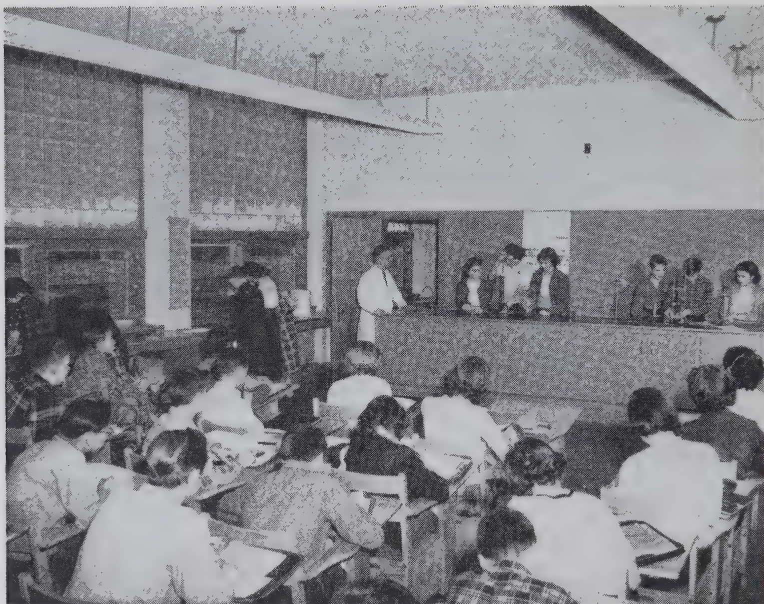

Photo: Government of Alberta

A greater variety of teaching in secondary schools.

The French-Canadian concept of the term "secondary" is somewhat different. In the Province of Quebec, after seven years of elementary school, students may continue their studies for eight years at a classical college. These colleges combine in one institution what are known to English Canadians as secondary and university levels of education, and emphasize the humanities as preparation for further training in a profession.

University Level

Higher education beyond high school graduation is carried on by degree-granting universities and colleges. Students prepare themselves for careers in Medicine, Law, Education, Engineering, Commerce, and other professions in the Arts and Sciences.

The teachers, who are called professors, lecturers or instructors (depending on their qualifications and seniority), have considerable

freedom in selecting the course content and in determining the method of presenting it. Research, writing and consulting work is carried on in addition to lecturing, and advanced students sometimes work with the staff on research projects.

Vocational Education

This area has assumed increasing importance in the last twenty years in order to meet the demand for skilled craftsmen and technicians resulting from wartime production and post-war industrial expansion. Vocational education and training, for practical purposes, has taken a wide variety of forms. In publicly operated schools it may be classified generally into three broad groups: *high school vocational courses*, *post-high school courses*, and *trade courses*. The subjects taught in such courses are not exclusively vocational, and may include some taught by academic teachers.

The high school group includes courses with a definite occupational objective, including a study of high school mathematics, science, language and social studies, and training in specific trade or business skills and theory. These courses are for youth attending high school.

The post-high school group includes advanced technical courses leading to employment as a technician and requiring the study of science and mathematics in a general or specific field at a higher level than that taught up to high school or junior matriculation.

The trade courses are designed to prepare youths and adults who have left the regular school system for entry into employment, or to help those already employed to advance in their jobs. This group includes courses which are a part of the apprenticeship training programs. The skills of the trades or occupations, as well as trade theory, mathematics, and sciences directly related to such occupations form the main content of the courses.

Approximately 200 provincial and municipal institutions offer technical and trade training in Canada: 20 to 25 offer mainly post-high school or advanced technical courses; 100 to 105 offer high school industrial courses; and 75 to 80 offer mainly trade courses. In addition there are a number of private trade schools and business colleges located throughout the country, and many firms operate their own staff training programs.

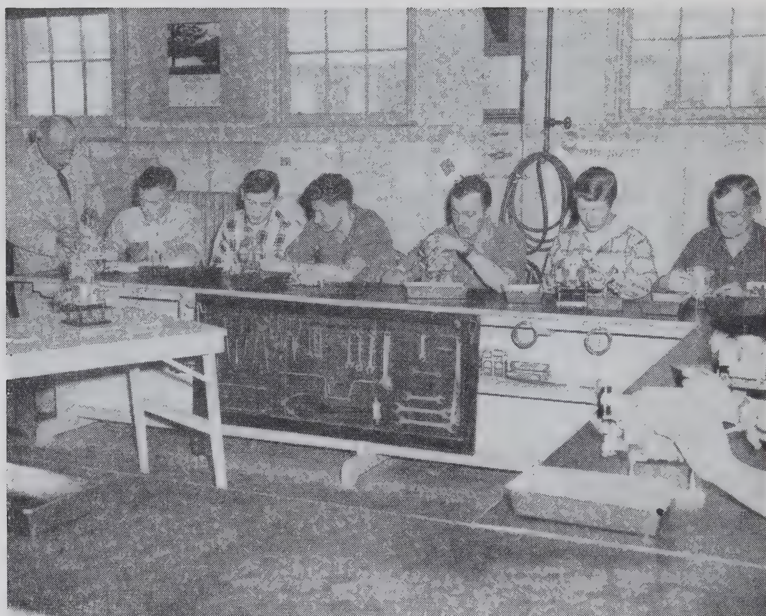

Photo: Government of New Brunswick

Vocational teachers must be experienced tradesmen, with teacher training.

The main requirement for teachers of vocational subjects and courses is that they bring with them extensive knowledge and skill gained in training and practical experience, in addition to the ability to impart these skills to students.

Specialized Education

The scope of education has broadened considerably in the last few years in recognition of the special needs of various groups. No longer is the opportunity for education restricted to those who fit into the regular school system. Classes are now held in children's hospitals, and there is special teaching for the hard of hearing, the blind, and otherwise physically afflicted, as well as for mentally retarded or mentally superior children. Corrective education for juvenile delinquents in reformatories and detention homes holds interesting possibilities.

Teachers in these fields must have a special understanding of, and sympathy for, the emotional problems and handicaps presented by the group with which they are working. Teaching certain groups may be extremely difficult and at times frustrating, but the work offers a real challenge to competent people. Special training and experience, in addition to regular teacher training, may be necessary.

The growing prevalence of adult education is opening another new field for teachers. Classes are usually held in the evenings and include a wide variety of academic and technical subjects.

DUTIES AND RESPONSIBILITIES

In examining the complex duties in the classroom it becomes apparent that *what* teachers do is no more important than *how* they do it. A great deal depends on the teacher's imagination, resourcefulness and enthusiasm in order to make the subject matter interesting and meaningful.

Photo: Government of Alberta

. . . in a manner that will stimulate interest.

Teachers supervise and direct students' activities, maintain class discipline and ensure that classroom or shop conditions are conducive to good learning. They carry out instruction in the subject or subjects for which they are responsible, in a manner that will stimulate interest and participation. They may use with advantage modern teaching techniques, and a variety of teaching aids, such as audio-visual material, demonstrations and projects.

In addition to instructing in the subject matter of the course, teachers have the responsibility of promoting good citizenship and a healthy attitude toward life in general, and assisting students to achieve the greatest possible development consistent with their present abilities, interests and aptitudes.

Aside from actual teaching duties, teachers must plan and prepare lessons, evaluate student progress, keep a variety of class and student records, prepare reports, maintain contact with other members of the school staff, and keep abreast of developments in the field of education. Much of this work is done outside regular school hours.

Frequently teachers become involved in activities not strictly related to teaching. The extent to which this occurs depends partly on their willingness and ability to engage in other school and community activity, and partly on the demands made upon them by their principal and by such organizations as Home and School Associations or other special-interest groups. These extra activities have important compensations. They allow teachers to become better acquainted with students and parents, to develop their own personal interests, and to make valuable contributions to community life.

Within limits, teachers are expected to encourage and counsel students who are having trouble either with school work or with personal problems. They also may be required to provide educational and vocational guidance to students planning their further education, although this function is becoming more and more the responsibility of teachers who specialize in guidance counselling.

PERSONAL QUALITIES

There is varied opinion on what personal attributes should be possessed by a teacher. Few individuals are likely to have all the qualities desirable in a good teacher, and students just graduating

from high school may not yet show the full promise of their personalities. There are, however, certain qualities that are considered essential to success and satisfaction in teaching.

Foremost is a sincere liking for and an interest in young people, and a desire to help them. From such an interest grows an understanding of the complex process of human development. Without this requisite, teaching would be meaningless and mechanical.

Teachers must have an enthusiasm for life, a scholarly thirst for knowledge and an appreciation of the value of human culture in order to rouse enthusiasm and to inspire in their students the desire to learn. Leadership — that indefinable quality that commands respect and obedience — is essential for the maintenance of class discipline.

And a sense of humour! Without this, teaching could be a grim affair. The ability to laugh easily, even at oneself, often helps to see one through a difficult situation.

Other qualities can be listed — good character, good grooming and appearance, a pleasant speaking voice — all of which are important assets for one who is considering teaching.

There are ways of exploring one's suitability for the teaching profession. Do you like to share your experiences with others? On babysitting jobs, do you entertain and read to your young charges, or is it merely a business proposition? Does education mean more to you than just an interlude to be endured? Have you ever thought of becoming a camp counsellor, or working with youth organizations such as the Boy Scouts, Girl Guides, the YMCA or YWCA? Interest or satisfaction in these activities can be taken as broad indications that you have at least some of the qualities required of teachers.

Future Teachers' Clubs

All students have the opportunity of seeing at close range at least the more obvious aspects of the teacher's work. The formation of Future Teachers' Clubs in schools has carried this opportunity to its obvious conclusion. In many localities, interested students, with the assistance and encouragement of the teaching staff, are now organized into study groups so that they may learn more about the teaching profession while they are still in school.

TRAINING

Training requirements for the certification of teachers in the public school system are specified by the provincial Departments of Education, and vary somewhat from province to province. There is also considerable variation in the minimum training required for certification of teachers at different levels. Training is available from provincially operated normal schools, teachers' colleges, or through university faculties of education. A summary of the training requirements is given in the Appendix. Further information is available on request from the provincial Departments of Education. Students who wish to make a career of teaching but feel they cannot meet the financial requirements should inquire of their principal or guidance counsellor about the many forms of student assistance that are available.[1]

The purpose of a teacher training course is to build on the foundation of a substantial body of academic or technical knowledge, gained in high school, university or in a trade, an understanding of the principles of the teaching technique. Courses include studies in the psychology of learning, the psychology of childhood and adolescence, the philosophy of education, and class management. A portion of the education period is usually devoted to practice teaching in actual classrooms.

A general outline of minimum requirements for teaching at the various academic levels is as follows:

Elementary Level

At present, in most provinces, the minimum educational standard for elementary school teachers is university entrance or high school graduation plus one year of teacher training.[2] Qualification as a nursery school or kindergarten teacher is similar, with specialized courses for this work being offered in some universities. Some proficiency in music and art is an asset.

Secondary Level

Generally, the minimum requirement is a bachelor degree in Arts, Science or Commerce followed by one year of professional teacher training. Some universities have Faculties of Education

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[1] DBS, Reference No. 55, *University Entrance Awards*, 1958.

[2] Certificates or Letters of Permission granted without this minimum qualification are usually valid for a limited time only, after which the holder, in order to continue teaching must return for further training, either at summer school, or during the regular term.

Photo: Government of Nova Scotia

Some teachers specialize in vocational guidance.

which offer 4 or 5-year courses combining professional and academic training. For the secondary school level, prospective teachers usually specialize in the subject or group of subjects they intend to teach. Specialist teachers in Home Economics, Physical Education or Guidance, for example, may be required to have a degree, or extra university courses, related to their specialty.

Universities

An Honour degree or Master's degree in a particular discipline is considered the minimum educational qualification, and a Doctorate is preferable. University professors and lecturers are not, as a rule, required to have formal teacher training. It is not uncommon for a highly qualified person who has been engaged in some other occupation to be appointed to a lectureship, either

on a full-time or a part-time basis. Thus it is that many professional people, such as eminent physicians and surgeons, lawyers, engineers, educators, and others practising in their fields, contribute to the advancement of higher learning.

Vocational Teacher Training

A recent survey of the publicly operated vocational training program in Canada[1] showed that in general, vocational teachers must have proficiency in the trade being taught, and in most cases they must have journeyman status with industrial experience. In addition, they are expected to qualify for a teaching certificate prior to, or shortly after, appointment to a teaching position. As a rule this can be done through attendance at summer school, often with the assistance of scholarships or bursaries. Teachers of technical skills at the post-high-school level may be required to hold university degrees.

The special qualifications demanded of teachers of vocational skills suggest that recruiting is primarily from industry.

ENTERING THE FIELD

The first step toward entering the teaching profession is to qualify for a teaching certificate issued by a provincial Department of Education. New entrants should be at least 17 years of age, and preferably not more than 45. A certificate of health may be necessary.

Teaching staff is hired directly by local school boards, usually through notices in newspaper employment columns. Employment opportunities are most numerous in the months of May, June and July, when school boards are contracting for teaching staff for the following year.

In recent years it has not been difficult for qualified teachers to obtain employment, and some school boards have found it necessary to accept applications from persons who were not fully qualified. It is generally agreed that the role of teacher is too important to be left in the hands of the partially trained, and there is considerable pressure to maintain a high standard of teacher qualification. It is probable, therefore, that in the future, entry into teaching will be possible only for the properly qualified.

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[1] Department of Labour, Ottawa, *Research Program on the Training of Skilled Manpower*, Report No. 5, 1958.

Teachers in private schools may not be obliged, by law, to have a provincial teaching certificate. Possession of such a certificate may be a condition of employment, however, as in this manner private schools are able to establish a recognized minimum standard of qualification for their teaching staff. Opportunities for employment in private schools are relatively scarce, as only a small fraction of the total number of teachers are so employed. Teaching positions with the federal government are advertised by the Civil Service Commission; a provincial teaching certificate is usually required.

Appointment to teaching positions in universities is usually made through the university Board of Governors. Notification of vacancies may be made through professional associations. Some universities offer teaching fellowships, with a stipend, whereby a university graduate of exceptional scholarship may pursue post-graduate studies at the university on condition that a certain number of hours be devoted to teaching. Undergraduate students interested in teaching fellowships should consult the university student counsellor.

The National Employment Service of the Unemployment Insurance Commission maintains an Executive and Professional Section to assist members of the various professions in finding employment. Qualified teachers seeking employment may register at the nearest office of the National Employment Service.

Teachers From Other Provinces

Teachers holding certificates from one province can usually obtain a "temporary" certificate allowing them to teach in another province. If the qualifications held by the teacher are acceptable, the temporary certificate is made permanent after a prescribed period of successful teaching. If they do not conform to the provincial standard, the teacher must arrange for further training in order to qualify for a permanent certificate.

Teachers From Abroad

Although provincial authorities make arrangements to absorb into the school system teachers trained in non-Canadian schools, differences in language and cultural background must be taken into consideration. It has been relatively easy for British teachers to continue their teaching careers in Canada.

Since education in Canada is mainly under provincial jurisdiction, interested teachers requiring information should apply directly to the Registrar, Department of Education, at the capital city of the province in which they wish to teach. Copies of credentials, proof of education, and related information should be enclosed for evaluation.

Some provinces have set up special requirements. The educational system of Newfoundland is denominational, therefore teachers, when applying there, should state their religion. Those applying to teach in the Roman Catholic schools of Quebec should include a certificate of character from their rector or parish priest. Generally speaking, teachers must be British subjects or prepared to take out papers for Canadian citizenship.

ADVANCEMENT

Teachers may advance by qualifying for certificates of a higher level. This may be done by attending summer school at university, or by taking undergraduate or graduate work for additional educational qualifications. Additional pay is granted for further education.

In larger schools, where a number of teachers teaching the same subject or related subjects are organized into a department, e.g., English, mathematics, science, etc., it is possible to become head of the department. Further advancement may be to vice-principal and eventually principal — not necessarily within the same school, but often through a process of transfer from school to school as opportunities present themselves. The principal may have administrative duties only, but is always an experienced teacher.

Further advancement may lead to administrative work as a superintendent or inspector. Higher officials of the provincial Departments of Education are invariably teachers, chosen for their executive ability and background in the field of education.

In universities there is a corresponding advancement from lecturer to assistant professor, associate professor, full professor to department head, to dean of a faculty. University presidents are usually selected from the university staff, but not invariably.

Advancement in this sense usually means an increase in the amount of administrative work and responsibility, with a corresponding reduction in actual teaching duties. It should be

kept in mind that the number of such posts is limited in comparison with the number of teachers. For good teachers who prefer to continue in their teaching role there is opportunity to enrich their working experience through study, travel and exchange teaching within this country and in other Commonwealth countries.

WORKING CONDITIONS

Generally speaking, teaching is clean, indoor work. Most school rooms are bright, and are designed to provide the best possible facilities for teaching. On the other hand, many schools are crowded with pupils, and taxed to the limit of their resources. Shortage of sufficient new school construction has made it necessary to hold in use many of the older, obsolete buildings. Overcrowded schoolrooms also tend to place an added strain on teachers.

Photo: Government of Alberta

Teaching is clean, indoor work.

A fairly widespread program of consolidation of small one-room and two-room rural schools into larger centralized units is gradually doing away with isolated rural teaching posts.

Classroom hours are usually from 9 o'clock in the morning to 3:30 or 4 o'clock in the afternoon. In schools where over-crowding has made it necessary to conduct classes in shifts there may be some variation from these hours. The teacher's day does not end with the regular school day. The preparation of lessons, marking of exercises, keeping of records, and many other tasks, all require time.

Teachers work a five-day week, with statutory holidays free, and usually ten days at Christmas and ten days at Easter unless, of course, a portion of these holidays is taken up with conferences and meetings. Employment is usually on a ten-month basis, leaving two summer months in which teachers are free to rest, take other employment or, as is often the case, add to their qualifications by attending summer school. Sick leave, frequently on a cumulative basis, is provided in all provinces. In every province a contributory pension scheme provides for retirement.

Earnings

Salaries for teachers in the public school system are based mainly on educational qualifications and length of service.

The following table is a simplified version of the very complex salary structure for teachers. Salaries are usually (but not always) higher in urban schools than in rural schools.

Yearly increments to base salaries range from $50 to $300 until the maximum is reached. Bonuses of $100 to $1,000 are paid for additional qualifications such as higher degrees and specialist certificates. With added qualifications and years of experience, teachers may thus increase their incomes considerably over the minimum salaries listed in the table.

Promotion to administrative or supervisory positions also increases salary. Department heads receive from $300 to $700 per year extra and vice-principals receive $300 to $1,500 extra, depending on the size and level of the school. Salaries of principals are usually based on the number of classes or the enrolment of the school, or the number of teachers supervised, as well as on the principal's educational qualification. Top salaries exceed $12,000 in some large urban secondary schools.

ANNUAL SALARIES OF TEACHERS IN SELECTED CANADIAN CITIES, SEPTEMBER 1958[1]

CITY		TRAINING				Possible Maximum Income of Classroom Teachers
		Level II		Level V		
		Min.	Max.	Min.	Max.	
		$	$	$	$	$
St. John's, Nfld.[2]		2,788	3,803	4,038	5,488	5,800
Charlottetown, P.E.I.	Single	2,250	3,150	2,650	3,550	3,750
	Married	2,850	3,750	3,250	4,150	4,350
Halifax, N.S.		2,200	3,550	3,100	5,350	5,950
Saint John, N.B.	Elementary	2,101	3,445	2,601	3,945	4,795–5,095
	Secondary	3,001	4,495	2,950	5,350	5,900–6,200
Montreal —						
Catholic School Commission						
	Women	2,300	3,800	2,750	4,250	4,750
	Single Men	2,700	5,000	3,150	5,450	5,950
	Married Men	3,200	5,500	3,650	5,950	6,450
Protestant School Board						
	Women	2,400	4,500	3,500	6,200	7,500
	Men	2,600	4,800	3,600	6,500	7,800
Ottawa —						
Public School Board		3,000	6,100	3,500	6,800	7,400
Collegiate Institute Board		—	—	4,200	7,300	8,100
Toronto —						
Board of Education		3,000	4,600	4,200	7,100	8,300
Hamilton		3,200	5,700	4,100	7,000	8,200
Sudbury		3,000	5,400	3,800	6,400	7,000
Winnipeg		2,600	3,650	3,500	5,800	6,750
Regina —						
Public School Board		2,800	4,300	3,900	5,900	6,300
Collegiate Institute Board		3,100	5,000	4,300	6,700	7,200
Saskatoon —						
Public School Board		2,600	4,000	4,000	6,000	6,600
Collegiate Institute Board		—	—	4,700	6,700	7,100
Edmonton Separate School Board		2,700	5,200	3,900	6,900	8,625–8,925
Calgary —						
Public School Board		2,600	5,600	3,800	6,800	7,720–8,020
Separate School Board		2,600	5,600	3,800	6,800	7,600–7,900
Vancouver		3,100	5,100			
	Elementary	—	—	4,000	6,500	6,700
	Jr. High	—	—	4,000	6,800	7,000
	Secondary	—	—	4,000	7,100	7,300
Victoria		3,200	5,000	4,200	6,600	7,260

[1] Salaries are given for the two levels at which many teachers begin their careers. Level II represents qualifications consisting of junior matriculation and two years of subsequent training for which a provincial teaching certificate is granted. Level V represents three years training beyond Level II [usually a university (B.A.) degree plus a year's teacher training]. Figures are taken from Report Number 96 of the Canadian Education Association Information Service, except in the case of St. John's, Newfoundland, Charlottetown, Prince Edward Island, and the Montreal Catholic School Commission.

[2] Sometimes supplemented.

It must be remembered that the figures quoted are indicative of the salaries being offered in a few selected Canadian cities at the present time. Teachers' salaries have been increasing in recent years, so that they are more in line with the dignity and respon-

sibility of the profession. Indications are that this trend will continue. Precise information on local salaries may be obtained from local school boards or from the provincial Departments of Education.

Salaries for university teachers in 1957-58 showed an overall increase of more than 14 per cent over the previous year. The median salaries for all Canada were as follows: deans, $10,810; professors, $9,051; associate professors, $7,162; assistant professors, $5,822; lecturers and instructors, $4,620.[1]

In addition to earnings from their regular teaching positions, a great many teachers increase their incomes by carrying out other teaching duties in evenings or weekends, by writing, or by performing consulting or other services for which their academic or technical background may have fitted them. During summer months many work at temporary jobs often unrelated to teaching.

Tenure of Employment

The right of teachers to retain their teaching positions, the conditions under which they may resign or be dismissed, have long been of concern both to teachers and to their employers, the school boards. Increasing attention has been paid to security of tenure and most provinces have now provided legal safeguards.

A probationary period of from one to three years is usually necessary for teachers employed by any school board or district for the first time. Probationary contracts may be terminated at the end of the period without reason being given. Following the probationary period, the teacher is placed on permanent contract which may be terminated only in December or June (except in cases of emergency affecting the school), and the reason for termination must be given. That is to say, in provinces where teachers have security of tenure, they may not be summarily dismissed without just cause, and they may appeal to a Board of Reference in case of any dispute.

Regulations governing the employment, transfer, resignation and dismissal of teachers are covered in detail in provincial School or Education Acts, and prospective teachers should become familiar with their legal rights and obligations.

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[1] DBS *Salaries and Qualifications of Teachers in Universities and Colleges 1957-1958.*

RELATED OCCUPATIONS

There are few occupations in which trained personnel are not called upon to teach beginners. This is the way in which human skills and knowledge have been passed on through the ages, and thus teaching can be related to all occupations.

But the art of teaching is a skill in itself, having to do with the mechanics of learning, with human relationships and a special attitude toward people. Teaching skills can be applied in other fields such as personnel work, social welfare, administration, psychology, sociology, and research.

TEACHER ORGANIZATIONS

On entering the profession, teachers automatically become members of the provincial teachers' association, with the exception of the Roman Catholic teachers of Quebec, for whom membership is voluntary.

With the exception of Quebec French-speaking federations, members of all provincial organizations (over 95,000 Canadian teachers) also belong to the Canadian Teachers' Federation, which maintains a permanent office in Ottawa. This organization is the national voice of the provincial associations; it provides a means of exchange of information, promotes the welfare and professional status of teachers, co-operates with governments and other agencies interested in the field of education, and carries out research. In August 1957 the Canadian Teachers' Federation established the Canadian College of Teachers to provide recognition for the work of outstanding teachers in Canada by honouring them with appointment to this body.

The Canadian Education Association is an organization maintained by the ten provincial Department of Education for purposes of liaison and information. Composed chiefly of local and provincial administrative officials and teacher-training personnel, its function is to study problems in education, to exchange information, prepare reports on developments in education and to carry out research. It maintains an information service supported in large part by the major urban school boards.

The Association Canadienne des Educateurs de Langue française (Association of the French-Language Educators of Canada), the French-language equivalent of the CEA, is similar in its organization and aims. The bulk of the membership, however, is concentrated in the Province of Quebec.

TRENDS

Need for Teachers

It is common knowledge that a shortage of teachers has existed since the end of World War II, and that the shortage became critical three to four years ago. There are a number of reasons why the supply of teachers has not kept up with the demand.

Demand

The number of school-age children in the population is a major factor affecting the demand for teachers. A substantial rise in the birthrate occurred following World War II, causing a great increase in the number of children reaching school age in 1952 and the years following. The birthrate has continued to rise slowly up to the present, so that a substantial school-age population is assured for years to come. The first surge of school children has passed through the elementary grades, is now in secondary schools, and will soon reach the universities. Not only are more pupils attending school, but statistics show that they are staying in school longer. As a result, an unprecedented strain has been placed on the entire educational system, marked by a shortage of schoolrooms and school teachers.

The growing importance of education is now recognized, with corresponding concern being expressed by governments, business, industry, organized labour and by the general public. In addition to the need for more and better schools, the need for an adequate staff of competent teachers is questioned by no one.

The concept of education may become broader as the schools take over functions formerly carried on in the home, and as increasing leisure time permits more adult education.

It is generally felt that the average teaching load (pupils per teacher) is too great, especially in larger cities, and should be reduced by adding more teachers to the teaching staff.

In spite of promising reports of improved teacher supply, the estimates of the overall future requirements for Canada are high. It has been estimated that nearly 50 per cent more teachers will be needed to take care of increased school enrolments within the next ten years. This estimate does not allow for replacement of the teachers (at least 15 per cent) who leave the profession every year for various reasons. There is also a substantial number of persons at the present time serving as teachers without any profes-

Photo: Government of Nova Scotia

More students . . . staying in school longer.

sional training, and many others whose educational and training qualifications are below the prescribed minimum of the province in which they teach.

At present there is a great need for teachers in the secondary schools, particularly for well-qualified teachers in science, mathematics, and other specialized subjects. As a larger number of students graduate from high school the teacher-need will be passed on to the universities. These institutions have already been affected by the fact that a larger proportion of high school graduates are now going on to higher education. Within the next ten years both university facilities and teaching staff will have to be expanded greatly to meet the needs of increasing enrolment.

Supply

The children born in the period 1933-1939 are now 17 to 25 years of age, and they form the young adult group from which

new workers in all occupations are being drawn. It was during that period of economic depression that Canada's birthrate reached a record low and consequently the crop of new workers is scarcely adequate to meet the demands of a rapidly expanding economy, particularly in the highly skilled and professional fields. In general, salaries for teachers have not been high enough to compete with better-paying trades and professions, and the teaching profession has not been able to attract sufficient numbers to its ranks. Aside from salary considerations, it was felt by many that teaching did not carry the prestige and status of other professions.

Certain measures to increase the immediate supply have been taken. Qualified teachers have been attracted from other countries (particularly the United Kingdom), but there are limits to the number of teachers who can be acquired through immigration. Short, intensive courses of teacher-training for high school graduates were deplored by those who feared the danger of lowering teaching standards.

With increased salaries, greater student-teacher aid, security of tenure and other improvements, it is likely that in the future the teaching profession will be able to attract a greater share of the available manpower. Already the first surge of students born following world war 2 are graduating from high schools and are contributing to a rapid increase in enrolments in teacher-training institutions.

Outlook

The outlook for prospective teachers is exceedingly bright at present. As the number of available teachers increases, however, educational authorities are likely to raise the minimum qualifications required for entry into the profession. Students intending to make a career of teaching should therefore get as much education as possible, and should be prepared to continue their studies in order to progress in the profession.

For those who have the personal qualities that combine to make a good teacher, few occupations offer such opportunity and scope for personal expression and development. The responsibilities and difficulties of the work are coupled with a deep satisfaction and sense of accomplishment in carrying out one of the most important jobs — that of preparing the children of today to become the citizens of tomorrow.

APPENDIX

VARYING PROVINCIAL REQUIREMENTS

The basic education necessary to enter teacher-training schools differs from province to province. There are usually several courses open to students, each with its own requirements, and each giving a different professional status. Certain subjects are often prerequisite, or a minimum percentage mark is needed for entry. Tuition fees range from $50 to $375 per year, but scholarships, bursaries, student-teacher loans and other forms of assistance are available. Interested students should consult the school guidance counsellor, the Department of Education, or teacher-training centre for further information.

The following summary lists, on a provincial basis, the majority of educational institutions where teacher training may be obtained, and gives some indication of certificates granted. Unless otherwise stated, these schools and universities are open to both men and women, and classes are in English.

TEACHER-TRAINING INSTITUTIONS, PREREQUISITES AND CERTIFICATES, BY PROVINCE

Name of Institution	Prerequisite for Entrance to Teacher-Training Courses	Years of Study	Certificate Granted
NEWFOUNDLAND			
Memorial University	Grade XI	1	First Grade Teacher's Certificate
		2	Associate Grade Teacher's Certificate
		3	University Grade Teacher's Certificate
		4	Graduate Grade Teacher's Certificate — B.A. (Ed.)
	B.A. or B.Sc. from a recognized university	1	Graduate Grade Teacher's Certificate
PRINCE EDWARD ISLAND			
Prince of Wales College and Normal School	Grade XII or 2nd Year Prince of Wales College	1	First Class A or B Licence
	1st year university or 3rd year Prince of Wales College	1	Superior First Class Licence, Level I
	B.A. or B.Sc. from a recognized university	1	Superior First Class Licence, Level IV

Name of Institution	Prerequisite for Entrance to Teacher-Training Courses	Years of Study	Certificate Granted
NOVA SCOTIA			
Provincial Normal College, Truro	Grade XI	1	Teacher's Licence 3[1]
	Grade XII	1	Teacher's Licence 2
	2 years' university	1	Teacher's Licence 1
Acadia	3 years' university	1	Professional Certificate III
Dalhousie	B.A. or B.Sc.	1	Professional Certificate II–B.Ed.
Mount St. Vincent[2]			
St. Francis Xavier	Professional Certificate II		
St. Mary's	plus 3 years' teaching experience	1	Professional Certificate I–Master's degree
NEW BRUNSWICK			
Teachers' College, Fredericton	Junior Matriculation	1	Teacher's License
Mount Allison	1 year university	1	Certificate I
University of N.B.	2 years' university	1	Certificate II
St. Joseph's	3 years' university	1	Certificate III
St. Thomas College	B.A., B.Sc., Bachelor of Teaching or Bachelor of Elementary Education	1	Certificate IV
Université St-Louis, Collège Maillet[2,3]	Post-graduate degree	1	Certificate V
QUEBEC[4]			
Normal Schools	Grade XI or Junior Matriculation	1	Diploma Class "C"
	Grade XI or Junior Matriculation	2	Diploma Class "B"
Teachers' Colleges[4]	Grade XI or Junior Matriculation	4	Diploma Class "A"–B.Ped.
	2nd year College	2	
	B.A.	1	
Special Normal Schools	Grade XI or Junior Matriculation	2	Special Diplomas: Kindergarten Schools; Schools for the deaf; Schools for the blind; Schools for retarded children
Macdonald College (Incorporated College of McGill University)	High School Leaving Certificate	1	Class III Certificate[5]
	High School Leaving Certificate	2	Class II Certificate[5]
	Senior High School Leaving Certificate	1	
McGill University	2 years' Macdonald College	2	Class I Certificate[5]–B.Ed.
Bishop's University	Bachelor degree	1	Class I Certificate[5]
University of Montreal (École normale secondaire)	B.A.	1	2nd degree College Teacher–B.Ped.

[1] The Teacher's Licence 3 is valid for only five years; during that time the teacher must have completed grade XII to qualify for a Teacher's Licence 2.

[2] Women only.

[3] Instruction in French.

[4] Because of the large number of teacher-training institutions (approximately 122, of which 50 are for teacher-training in religious orders), it was considered impractical to list all of them. Those included were selected because they most closely resembled the pattern of the nine other provinces, i.e., they are open to both men and women.

The principal English Catholic teachers' college is St. Joseph Teachers' College, Montreal. Instruction in most normal schools and teachers' colleges is in French.

[5] Permanent certificates of the same class may usually be obtained after two years' successful teaching or on completion of additional university courses.

Name of Institution	Prerequisite for Entrance to Teacher-Training Courses	Years of Study	Certificate Granted
ONTARIO			
Teachers' Colleges at: Hamilton, London, North Bay, Ottawa, Peterborough, Stratford, Toronto	Secondary School Graduation Diploma of the General Course	2	Interim Elementary School Teacher's Certificate[5]
	Grade XIII or 1 year university	1	
University of Ottawa Teachers' College[6]	Secondary School Graduation Diploma of the General Course (English or French)	1	Interim Second Class Certificate[5]
	Grade XIII or 1 year university (English or French)	1	Interim Elementary School Teacher's Certificate[5]
Ontario College of Education (University of Toronto)	B.A. or B.Sc.	1	Interim High School Assistant's Certificate[5]—Type A or B
MANITOBA			
Manitoba Teachers' College	Grade XII or 1st year university in Arts or Science	1	Certificate to teach in elementary or junior high school grades
Brandon College	Grade XII or 1st year university in Arts or Science	1	Certificate to teach in elementary or junior high school grades
	3rd year University of Manitoba or B.A. or B.Sc.	1	Certificate to teach in high school—B.Ped.
		2	B. Ed.
University of Manitoba	3rd year University of Manitoba or B.A. or B.Sc.	1	Certificate to teach in high schools—B.Ped.
		2	B.Ed.
SASKATCHEWAN			
Teachers' Colleges at: Moose Jaw, Saskatoon	Grade XII, Senior Matriculation	1	Interim Standard Certificate, to teach grades I to X[5]
University of Saskatchewan, Saskatoon	Bachelor degree	1	Professional Certificate to teach grades I to XII
	Senior Matriculation	2	Standard Certificate, to teach grades I to XI
		4	Professional Certificate—B.Ed.
ALBERTA			
University of Alberta: Edmonton, Calgary	High School Diploma[7]	1	Interim Junior Elementary[5]
	Senior Matriculation	2	Standard Elementary[5] / Standard Secondary[5]
		3	Professional Certificate[5]
		4	B.Ed.
University of Alberta: Provincial Institute of Technology and Art, Calgary	Senior Matriculation	2	Standard Secondary,[5] to teach any academic or shop course up to grade XI
		4	B.Ed. (Industrial Arts), final year taken in Edmonton

[5] Permanent certificates of the same class may usually be obtained after two years' successful teaching or on completion of additional university courses.
[6] Bilingual instruction.
[7] Standing in certain grade XII subjects required.

Name of Institution	Prerequisite for Entrance to Teacher-Training Courses	Years of Study	Certificate Granted
BRITISH COLUMBIA Victoria College	University entrance	1	Elementary Conditional Certificate — valid four years
College of Education, U. B. C.	University entrance	2	Elementary Basic Interim Certificate
	Grade XIII or 1st year university	1	
	University entrance	4	Professional conditional Certificate
		5	Professional Basic Certificate

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FILMSTRIP

The Department of Labour has collaborated with the National Film Board in producing, in colour, the filmstrip *Teacher*, based on this monograph. It describes, with authentic pictures, the nature of the work, training, working conditions, employment outlook, and other aspects of the profession.

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

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The Social Worker

Technical Occupations in Radio and Electronics

Bricklayer and Stone-Mason

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Careers in Home Economics

Motor Vehicle Mechanic

Mining Occupations

Draughtsman

Careers in Construction

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Sheet-Metal Worker

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(1) Carpenter
(2) Bricklayers and Stone-Masons
(3) Plasterer
(4) Painter
(5) Plumber, Pipe Fitter and Steam Fitter
(6) Sheet-Metal Worker
(7) Electrician
(8) Machinist and Machine Operators (Metal)
(9) Printing Trades
(10) Motor Vehicle Mechanic
(11) Optometrist
(12) Social Worker
(13) Lawyer
(14) Mining Occupations
(15) Foundry Workers
(16) Technical Occupations in Radio and Electronics
(17) Forge Shop Occupations
(18) Tool and Die Maker
(19) Railway Careers

Careers in Natural Science and Engineering: (20-35, one booklet)

(20) Agricultural Scientist
(21) Architect
(22) Biologist
(23) Chemist
(24) Geologist
(25) Physicist
(26) Aeronautical Engineer
(27) ——
(28) Chemical Engineer
(29) Civil Engineer
(30) Electrical Engineer
(31) Forest Engineer and Forest Scientist
(32) Mechanical Engineer
(33) Metallurgical Engineer
(34) Mining Engineer
(35) Petroleum Engineer

(36) Hospital Workers (other than Professional)
(37) Draughtsman
(38) Welder
(39) Careers in Home Economics
(40) Occupations in the Aircraft Manufacturing Industry
(41) Careers in Construction
(42) Medical Laboratory Technologist
(43) Careers in Meteorology
(44) Teacher
(45) Physical and Occupational Therapist.

All monographs in the CANADIAN OCCUPATIONS series are priced at 10 cents per copy, with the exception of *Careers in Natural Science and Engineering*, which is 25 cents. A discount of 25 per cent is allowed on quantities of 100 or more of the same title.

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MONOGRAPH 45

HON. MICHAEL STARR, MINISTER
A. H. BROWN, DEPUTY MINISTER

DEPARTMENT OF LABOUR, CANADA

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FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of this series, and space is left in the last few pages of each monograph in which to note changes and other local information concerning the occupation.

This series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

This monograph was prepared by Mary E. Stuart under the direction of William Allison, Chief of the Occupational Analysis Section. Grateful acknowledgement is extended to the Canadian Physiotherapy Association and the Canadian Association of Occupational Therapy; the schools of physical and occupational therapy at McGill University, Université de Montréal and University of Toronto; the Ontario Workmen's Compensation Board Rehabilitation Centre, Toronto, and the Occupational Therapy and Rehabilitation Centre, Montreal, for their help and co-operation.

DIRECTOR,
Economics and Research Branch,
Department of Labour, Ottawa.

January 1959.

PHYSICAL AND OCCUPATIONAL THERAPIST

Photo: Occupational Therapy and Rehabilitation Centre, Montreal

Physical therapy is the treatment of disease by physical and mechanical means

HISTORY AND IMPORTANCE

The complexity of modern medicine has led to a great degree of specialization. The doctor, who is often a specialist, and the nurse, form the nucleus of a team that now includes the X-ray technician, the medical laboratory technologist, the medical social worker, the psychologist, the rehabilitation counsellor, the physical therapist and the occupational therapist. It is with the last two groups of workers that this monograph is concerned.

Physical therapy, which is the treatment of disease by physical and mechanical means, may be said to derive its origin from the use, since ancient times, of heat, exercise and massage to relieve pain and to restore body movement impaired by injury or disease. Thus healers of all ages have used these means as an aid to medical treatment which, in many cases, were the only effective treatment known.

Photo: The Workmen's Compensation Board of Ontario

Occupational therapy makes use of the arts and crafts to provide goal-directed activity

As a result of Man's inventiveness, new forms of physical therapy were introduced and the old methods were refined. Electricity was used for muscle stimulation and for ultra-violet and infra-red radiation. The use of hot paraffin wax and agitator baths were refinements of the application of heat and massage. A better understanding of the psychological, physiological and mechanical processes of the body and its own remarkable recuperative powers led to more knowledge of the value of physical and occupational therapy.

The advance of medical science increased the need for physical therapy. The lives and limbs that might otherwise have been lost were being saved by new surgical and medical techniques which required, as a sequel, the application of physical therapy to restore and re-educate muscle function.

Occupational therapy is similar to physical therapy in that it has the same basic purpose — to restore and re-educate muscle function. The difference lies in the methods used. Occupational therapy makes use of the arts and crafts and recreation to provide goal-directed activity for patients who are recovering from injury or disease. Some aspects of it were used for many years as a means of keeping long-term patients "occupied" to counteract boredom. Eventually the medical profession realized that, with proper direction, occupational therapy was a valuable supplement to medical treatment. It not only provided an additional form of therapy, but it also had valuable side effects, such as greater patient co-operation and improved patient morale.

The development of physical and occupational therapy led to the appearance of special therapists skilled in the performance of these techniques. It was after the outbreak of World War I that they first came into prominence and gained professional status. At that time the medical profession and auxiliary workers were mobilized to restore sick and wounded soldiers to physical and mental health. The new therapists emerged as distinct occupational groups. The physical therapists formed a professional association in 1920, followed in 1926 by the organization of the occupational therapists.

The advances made were strengthened during World War II, when thousands of injured servicemen and civilians were saved by modern medicine and surgery. The skill and patience of physical and occupational therapists made a significant contribution in this work and established them as recognized members of the medical team.

The position thus gained has carried over into peacetime rehabilitation practice. There is still a great need for physical and occupational therapy as medicine does more and more to restore victims of disease, congenital deformity and accidents. There is at present a shortage of qualified physical and occupational therapists to provide the service required as a result of expanding medical services and a growing awareness of the need for civilian rehabilitation.

NATURE OF THE WORK

Physical therapists and occupational therapists work under the direction of medical doctors, and often in conjunction with other members of the medical team. In conference, the doctor outlines

the history of each case and charts a course of treatment, prescribing the physical and occupational therapy required. Old cases are reviewed from time to time, progress is evaluated, and any necessary changes in prescription are made.

Except in some centres where one person may perform both types of therapy, the work of the physical therapist is likely to be quite separate and different from that of the occupational therapist. For this reason, the duties are outlined under separate headings.

DUTIES OF PHYSICAL THERAPIST

The physical therapist, often called a physiotherapist, gives medically prescribed treatments designed to correct muscle ailments and deficiencies. She administers therapeutic baths (hydrotherapy), ultra-violet or infra-red rays and other electrical stimula-

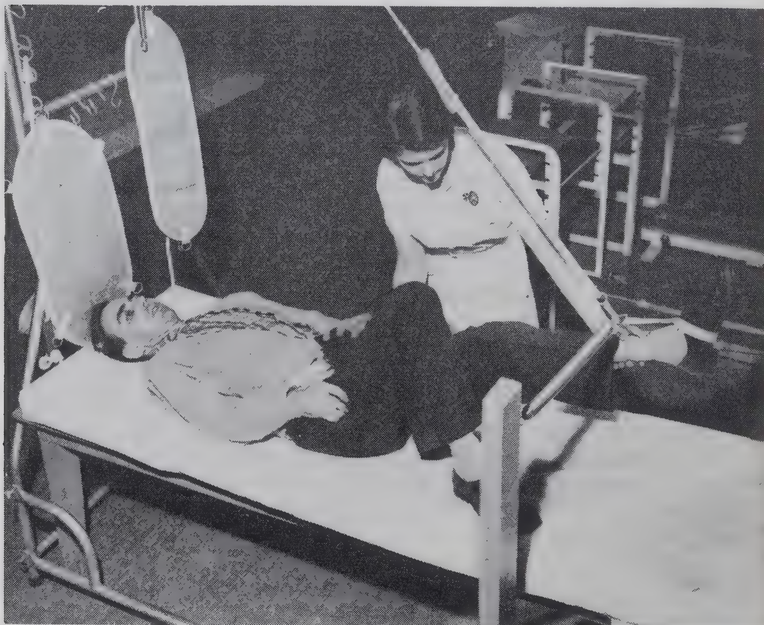

Photo: Occupational Therapy and Rehabilitation Centre, Montreal

The physical therapist applies various body manipulations

tion (electrotherapy and diathermy), and applies various body manipulations, including exercise and massage.

The physical therapist may arrange for treatments according to her schedule, spending some time on the wards for bed patients, at other times giving treatments in the Physical Therapy Department. In a large department, the therapist may attend a number of patients at one time, massaging, assisting and directing with exercises, setting up and operating a variety of electrical or mechanical equipment. At times, groups of patients may be instructed in remedial exercise. She may assist patients into and out of hydrotherapy baths, exercising the injured limbs while they are immersed. As the methods and objectives of physical therapy are fairly straightforward, the therapist is able to explain the aims of treatment in terms the patient can understand. She moves from one patient to another, assisting, correcting, explaining and encouraging, as they work toward their own cure. Often, the physical therapist is involved with the fitting of artificial limbs and other prosthetic appliances and teaching patients how to adapt to and use them. An important part of her work is to secure the patient's active participation to achieve the desired result and to restore his self-confidence.

In order to measure the progress being made, the therapist has the patient exercise on various types of resistance equipment (often of her own invention) that is calibrated to show the increased power or function of a limb. She may also test the patient's ability to cope with real-life situations, such as using crutches or artificial limbs to climb stairs, to get on and off a simulated bus exit, or to perform certain activities required in his or her daily work. The latter, however, may be in the realm of the occupational therapist's work.

DUTIES OF THE OCCUPATIONAL THERAPIST

The occupational therapy program usually includes a workshop, a storeroom for materials and a variety of arts, crafts and recreational activities that are offered to or selected by the patient. Each activity must, in one or more ways, satisfy certain basic requirements. It must provide stimulation and exercise for the affected part; it must hold the interest of the patient and help to relieve undesirable tension and anxiety; it must provide the patient with a feeling of accomplishment.

Photo: The Workmen's Compensation Board of Ontario

The occupational therapist plans work projects for patients

The occupational therapist carries out the occupational therapy program in accordance with the particular needs of the hospital or centre in which she works. Under the doctor's direction, she plans and organizes work projects for patients and may supervise workers who teach and direct the various therapeutic activities. The occupational therapist may also study the reactions of patients while they work or play and watch for indications of progress or regression.

The particular duties vary depending on the needs of the patients with whom the therapist works. At times the emphasis is on physical restoration; at other times, particularly in mental hospitals, the emphasis is on the psychological benefits of therapy. The therapist must plan and organize her work to a schedule that includes ward visits and workshop supervision. She may be responsible for ordering material, tools and equipment and may at times become involved in the sale of projects produced as a by-product of treatment. She usually keeps a record of her activities and observations for use by the physician.

In a rehabilitation centre which is engaged in refitting workers for employment and daily living, the occupational therapist, with some ingenuity, can duplicate many of the work situations that patients will encounter when they are discharged. Thus, injured linesmen can practise climbing poles and ladders; railroad workers may lay rails and load dummy boxcars; bricklayers, plasterers, painters, carpenters and machinists may have practice with the tools of their trade, all under the watchful eye of the therapist. The occupational therapist may also instruct patients in the most efficient way to work within the limits of their disability.

There are times when an injured worker cannot return to his original trade because of residual disability. The therapist may then be able to furnish valuable information about the remaining abilities that can be used in his rehabilitation in a new trade.

The therapist also works with women who must overcome disability in order to care for their families or to seek employment. She can assist by teaching them simplified homemaking techniques and how to care for their homes and families in spite of even serious disability. For those who may seek employment, many of the work projects, such as typing, machine sewing or artwork, are directly applicable to vocational skills.

PERSONAL QUALITIES

Although adequate training is essential to becoming a qualified therapist, there are also many personal qualities that should be considered by those intending to enter this field. Because the training extends from two to four years beyond high school at university level, one should be above average in scholarship. In Canada, the majority of entrants to the field are women, although there is opportunity for men.

Working with sick people, many of whom may be frightened, discouraged or in pain, demands that, in addition to cheerfulness, patience and sympathy, the therapist should have a mature, healthy attitude toward illness and disability in all its forms.

As in all the healing professions, a genuine interest in people and their welfare, almost to the point of dedication, is the basis of therapeutic service. Good health, stamina and reasonable

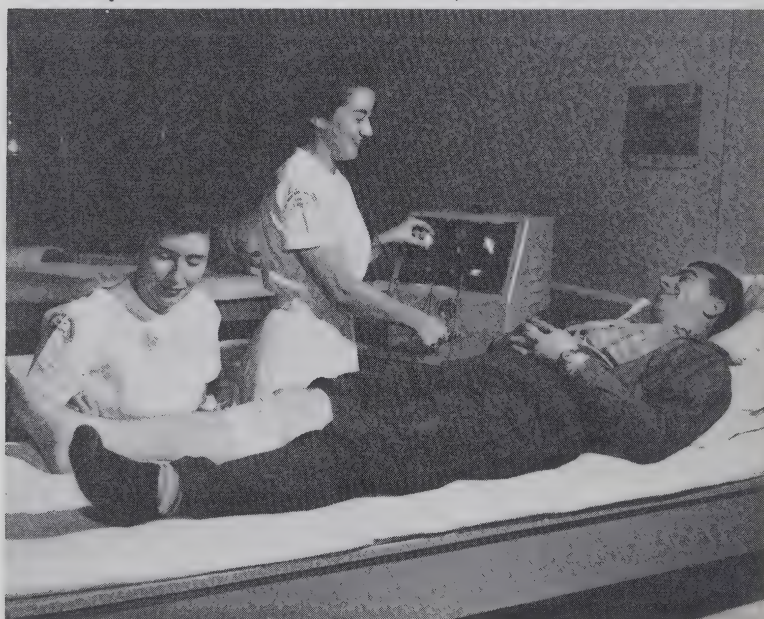

Photo: The Workmen's Compensation Board of Ontario

Working with sick people demands cheerfulness, patience and sympathy

strength are necessary, particularly in the case of the physical therapist, whose duties may at times involve considerable expenditure of energy. In most cases trainees must pass a medical examination and have a personal interview with the head of the school.

The challenge of disability is seldom the same, and each case presents a different set of problems. The therapist must, therefore, be resourceful and flexible in her approach. Ingenuity and inventiveness are often required to adapt existing equipment to new uses, or to develop new apparatus out of material at hand. Good organizing ability is necessary in order to plan and administer the work of the department with a minimum of supervision.

Taken at face value, the work of the occupational therapist would appear to require a strong interest in the arts and crafts. Although this interest is desirable, it should not in any way obscure the primary importance of the therapeutic aim, nor need the therapist be a perfectionist with regard to handicraft, which is a means to an end and not an end in itself.

PREPARATION AND TRAINING

In general, preparation and training for physical and occupational therapy requires high school graduation or equivalent, followed by two to four years of professional education at a university. Students intending to prepare for this field should communicate with the Registrar of the school of their choice *prior to their last year in high school*, in order to ensure that they will have the minimum requirements for admission to the school. Applications should be made early, as most schools have limited accommodation.

Two patterns of training have developed. One is a combined Physical-Occupational Therapy course in which students follow a program of study and practical training that qualifies them to work in both areas; the other pattern leads to qualification in only one of the two areas.

The combined course, although longer, has the advantage of giving the student a better understanding of the aims and methods of both fields, even though she may choose to practise in only one. Also, the combined course equips the therapist to work in centres requiring her to give both types of treatment. In addition, it is felt that younger students need the extra time in which to mature and develop to carry the responsibilities of the work.

The following courses are being offered:

McGILL UNIVERSITY, MONTREAL

Degree Courses B.Sc. (P. & O.T.)

Length of Course: 5 years. Junior Matriculation, with an average of 70 per cent.

4 years. Senior Matriculation, with English, trigonometry, algebra, physics, chemistry and biology.

Fees: $500 per year, plus student fees, and approximately $75 for books, uniforms and other expenses.

Diploma Course (either Physical Therapy *or* Occupational Therapy).

Length of Course: 3 years with Junior Matriculation.
2 years with Senior Matriculation.

Fees: $500 per year, plus student fees, books, etc.

UNIVERSITY OF MONTREAL

Diploma Course (Combined Course)

Length of Course: 3 years. Senior Matriculation, including applied chemistry and physics.

Fees: $375 per year, plus student fees, books, etc.

Language: This is the only course conducted in French, although some of the lectures are in English.

UNIVERSITY OF TORONTO

Diploma Course (Combined Course)

Length of Course: 3 years. Senior Matriculation with nine upper school papers, including physics and chemistry.

Fees: $380 per year, plus student fees, books, etc.

UNIVERSITY OF ALBERTA

Diploma Course (Physical Therapy only)

Length of Course: 2 years. Senior Matriculation with physics and biology.

Fees: $230 per year, plus student fees, books, etc.

This course includes periods of internship following the first and second years. Students receive an honorary payment for services during these periods.

All schools offer courses that are a combination of academic and practical studies. Courses include the study of human anatomy, psychology, pathology, aspects of medicine and surgery, physiology and psychiatry. Students in the combined courses, and in physical therapy, study electrotherapy (the application of various electric currents in treatment and the factors governing safety in the use of electro-medical equipment), the theory of bodily movement and its application in therapy, and the re-education of muscle function after injury and disease. Practical training is

received in teaching hospitals and rehabilitation centres under the supervision of graduate therapists.

The occupational therapy course covers the basic principles of therapy from the point of view of occupational activity, the adaptation of equipment in the treatment of medical and surgical conditions, and the study of occupational therapeutic techniques and their application to specific disabilities. A study of rehabilitation, with emphasis on job analysis, work testing, and pre-vocational assessment, is also included. Both professional associations require that graduates spend specific periods of internship in order to qualify for membership.

More information concerning the aims and content of courses is contained in the individual school calendars, together with up-to-date information regarding fees and other expenses, admission requirements, and other important aspects of school attendance.

Post-Graduate Courses

The University of Toronto and McGill University offer two-year post-graduate courses in physical therapy and occupational therapy. These courses are open to graduates of approved schools who have had at least two years in practice, and are designed to give a wider background of knowledge, with opportunity to study and work out problems that have been encountered. Graduates are then qualified to teach occupational or physical therapy in any Canadian university, or to take a position in a teaching hospital.

Bursaries and Other Educational Assistance

Information regarding scholarships, bursaries and various loan funds may be obtained from university Registrars, and from the provincial Departments of Health.

WORKING CONDITIONS

Most therapists work in a hospital or clinical setting, where surroundings are clean, well lighted, airy and pleasant. The amount of ward work may depend on the type of treatment offered by the hospital. The environment of the occupational therapy department is somewhat less medical in appearance, a substantial amount of the work being carried on in a workshop, or with occupational projects, appliances and devices.

Photo: Occupational Therapy and Rehabilitation Centre, Montreal

Most therapists work in a hospital or clinical setting

Generally, therapists work a 35 to 40-hour week, with occasional overtime. Week ends are usually free, particularly in rehabilitation centres and clinics. Some therapists may have to make home visits, in which case they must be able to drive a car.

Employment is steady, and not subject to seasonal variation. Holidays with pay vary from two to four weeks, depending on the policy of the employing institution. Married women find ready employment, either on a full-time or part-time basis and all qualified therapists may move freely from province to province.

Earnings

Remuneration is on a level with that received by other workers in the medical field with a similar level of training. The salaries being paid to physical and occupational therapists by the

Government of Canada, which may be considered as roughly indicative of salary levels generally, are as follows:

Grade 1	$2,550 —	$2,910	(starting grade)
2	3,210 —	3,660	(two years' experience)
3	3,720 —	4,170	(supervisory duties)
4	4,050 —	4,500	(supervisory duties)

In some cases uniforms are laundered and noonday meals are provided. Most therapists "live out", but isolated institutions may provide board and lodging at reasonable rates. Information regarding pension plans, sickness benefits and other perquisites should be obtained from the prospective employer.

Therapists who are accepted in the Armed Forces receive the rank and pay of an officer. Those who fill teaching, executive and administrative positions may receive salaries exceeding those listed above.

Licensing

Physical therapists wishing to practise in some provinces must first obtain a license from the provincial Licensing Board. As licensing regulations are subject to frequent change, enquiries should be directed to the Canadian Physiotherapy Association. No regulations have been set up as yet for occupational therapists.

PLACES OF EMPLOYMENT

Physical therapy and occupational therapy find application in many branches of medicine. Hospitals are the chief employers. A large hospital may have as many as twenty or more therapists on its staff. If two or more therapists are employed, the work is likely to be departmentalized, with one department engaged solely in physical therapy, the other in occupational therapy. In a small hospital a single therapist may be required to provide both physical and occupational therapy.

Hospitals differ in their requirements. Those in which surgical treatment predominates and the period of hospitalization is relatively short are more likely to employ a larger number of physical therapists. On the other hand, hospitals providing long-term treatment are more likely to employ a larger number of occupational therapists. D.V.A. hospitals or hospital wings, children's hospitals, tuberculosis sanatoria and mental hospitals

have been the chief employers of physical therapists and occupational therapists.

Rehabilitation centres established by the provincial Workmen's Compensation Boards in Alberta, British Columbia, Quebec and Ontario, for the rehabilitation of workers injured in industrial accidents, are an important source of employment for therapists. In addition to these provincially supported centres, rehabilitation clinics are operated by municipal bodies or welfare agencies.

ENTRY

There are plenty of employment opportunities for qualified therapists. The two professional associations maintain liaison between employers seeking staff and therapists seeking employment. Also, their Journals carry notices of openings.

The Executive and Professional Division of the National Employment Service is prepared to give every assistance to those seeking employment in this field.

Notices of competitions for physical and occupational therapists in the federal government are posted from time to time in public buildings across Canada, or information may be obtained by writing to the Civil Service Commission, Ottawa.

Opportunities for Non-Canadians

Although there is a demand for trained physical and occupational therapists in Canada, qualified persons from countries other than the United Kingdom may have some difficulty in becoming established. Problems of language, and certain differences in training, are the chief difficulties for therapists coming from continental Europe. In Canada, for example, the physical therapist must be qualified to give electrotherapy. This is not the case in some countries. Because of variations in training, many hospital administrators rely on the professional associations to investigate the qualifications of individual applicants trained outside of Canada.

Persons proposing to immigrate with a view to practising physical or occupational therapy in Canada should write to the Executive Secretaries of the Associations in advance, stating in detail their qualifications and enclosing copies of certificates. The Associations are in the best position to give information regarding

Photo: Occupational Therapy and Rehabilitation Centre, Montreal

A disabled housewife learns simplified homemaking techniques

opportunities that exist in various parts of the country, details of provincial licensing regulations, courses that may be taken in order to meet requirements, and where special examinations may be arranged.

ORGANIZATIONS

Physical Therapists

Qualified physical therapists may belong to the Canadian Physiotherapy Association, 8 Bedford Road, Toronto, Ontario. The *Journal of the Canadian Physiotherapy Association*, published quarterly, is the official publication.

Occupational Therapists

Qualified occupational therapists may belong to the Canadian Association of Occupational Therapy, 331 Bloor Street West, Toronto, Ontario. The official publication of this Association is the *Canadian Journal of Occupational Therapy*, (quarterly).

Graduates of the combined physical-occupational therapy courses may take out membership in both associations.

The aims and functions of the organizations are to promote the interests of their membership; to advance the standards of qualification and training; to maintain a registry of qualified therapists, and to provide an advisory and consulting service in all matters pertaining to the profession.

In many centres where there are sufficient numbers of workers, local groups have been formed for study and fellowship.

RELATED OCCUPATIONS

There are a number of occupations in which the techniques of physical and occupational therapy could be used to advantage, although in most cases additional training is required. Some possibilities are: teaching of physical training, and conducting recreational programs in schools, recreational centres, the Y.W.C.A. and Y.M.C.A. Many trained nurses are also therapists.

TRENDS

Number in the Occupation

For various reasons, the precise number of therapists in Canada is not known. In the 1951 Census of Canada they are not separated in the category "Other Professionals". Membership in the Canadian Physiotherapy Association is over 1,000 in active practice and in the Canadian Association of Occupational Therapy over 575. As many therapists are members of both organizations these figures cannot be added because of double counting. It is

likely that a number of therapists qualified to join are not members of either organization, and there is undoubtedly a large number of practising therapists who are not fully qualified.

Present Demand and Supply

At present, the demand for qualified physical and occupational therapists greatly exceeds the supply. The rapid expansion of medical services and the increasing use of physical therapy in medical practice, has created an unmet demand for workers in this field. In addition, the development of civilian rehabilitation programs as an extension of medical service is adding to the demand for the specialized skills of the physical and occupational therapist.

These workers comprise a comparatively new professional group, and facilities are limited in the number of students that can be trained at one time. Although schools are being expanded, the annual number of new graduates available is only about 140 — little more than sufficient to replace losses to the profession due to marriage and other reasons. Because of the many therapists who are of marriageable age, loss through marriage is quite high. It is possible, however, that a certain number of married women return to the profession in later years.

Acquisition of therapists through immigration has been an important factor in meeting the demand.

Outlook

Advances in medical diagnosis, treatment and surgery may be expected to save the lives of an increasing number of people, many of whom may require physical and occupational therapy for maximum restoration. The extension of life expectancy also leads to a greater incidence of diseases common to old age, such as arthritis, rheumatism, heart disease and other disabling conditions which may respond to physical and occupational therapy.

It is logical to assume that the need for physical and occupational therapists will continue, and probably increase, as doctors make greater use of their services. Also, the establishment of a national hospital insurance program, the continued expansion of civilian rehabilitation services, and a wider public understanding and acceptance of physical and occupational therapy should increase the demand for workers in this field.

FURTHER READING

The Guidance Centre, Ontario College of Education, Monographs *Physical Therapist* (revised 1958) and *Occupational Therapist* (revised 1958).

Department of Labour, Ottawa, "Canada at Work" radio talks *Physiotherapy and Rehabilitation* (October 12, 1958), *Occupational Therapy in Rehabilitation* (October 19, 1958).

Ministry of Labour and National Service, London, Eng., "Choice of Careers", New Series No. 52, *The Physiotherapist and The Remedial Gymnast* (revised 1958) and No. 53, *The Occupational Therapist* (1954).

Civil Service Commission, Ottawa, *Opportunities for Graduates in Medical Sciences, Dietetics and Social Work.*

U.S. Department of Labor, Women's Bureau, *The Outlook for Women As Occupational Therapists* (1952) and *The Outlook For Women As Physical Therapists* (1952).

B'Nai B'Rith Vocational Service Bureau, Washington, *Careers in Occupational Therapy* (1955) and *Career As a Physical Therapist* (1952).

Journal of the Canadian Physiotherapy Association, 8 Bedford Road, Toronto, Ontario (quarterly).

Canadian Journal of Occupational Therapy, Canadian Association of Occupational Therapy, 331 Bloor Street West, Toronto, Ontario (quarterly).

The American Journal of Occupational Therapy, 33 West 42nd Street, New York 36, New York (bi-monthly).

Archives of Physical Therapy, American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago, Ill. (monthly).

Physiotherapy Review, 737 North Michigan Avenue, Chicago, Ill. (bi-monthly).

Physiotherapy, Journal of the Chartered Society of Physiotherapy, Tavistock House (S), Tavistock Square, London, Eng. (monthly).

LOCAL INFORMATION

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CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

- Plumber, Pipefitter and Steamfitter
- Careers in the Engineering Profession
- The Social Worker
- Technical Occupations in Radio and Electronics
- Bricklayer and Stone-Mason
- Printing Trades
- Careers in Natural Science
- Careers in Home Economics
- Motor Vehicle Mechanic
- Mining Occupations
- Draughtsman
- Careers in Construction
- Sheet Metal Workers
- Machine Shop Occupations
- Careers in Meteorology
- Medical Laboratory Technologist (in colour)
- Teacher (in colour)

DEPARTMENT OF LABOUR

Economics and Research Branch

CANADA, 1959

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Other photographs: National Film Board of Canada.

Canadian Occupations
Monograph 46

OFFICE OCCUPATIONS

Prepared
by the
Economics and Research Branch
of the
Department of Labour, Canada

HON. MICHAEL STARR
MINISTER

A. H. BROWN
DEPUTY MINISTER

80441-9—1

FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

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This monograph was prepared in the Occupational Analysis Section by Helen Traynor under the direction of William Allison. The generous assistance of the following is appreciated: the National Secretaries Association, the Bell Telephone Company, the Civil Service Commission of Canada, the Women's Bureau of the Department of Labour and various office machine companies.

W. R. DYMOND,
Director,
Economics and Research Branch,
Department of Labour.

January 1960.

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CONTENTS

THE OFFICE AS A FIELD OF EMPLOYMENT

The Office is a base of operations for the administration of an enterprise, for contact with outside establishments and individuals, and for record-keeping. These three functions are the source of many clerical occupations.

HISTORY AND IMPORTANCE

Scribes were the first clerical workers. Some were appointed to record the king's activities; others chronicled religious events and still others wrote down laws and judgments of the courts as they were made. In ancient days merchants had scribes write letters, draw up contracts and deeds of sale, and keep records of goods and business transactions—a relationship similar to that of employer and office worker today. The scribes laboriously inscribed characters on clay and wax tablets, papyrus and parchment scrolls, using stylus or quill—the writing implements of their period.

Records show that man signed his name or mark to a contract as early as 3000 B.C. Tales are written of the first commercial travellers risking dangerous journeys of months and even years carrying, as the first letters of credit, clay tablets bearing an inscription over the king's seal. Agreements of all sorts, buying and selling of property, money-lending at 20 per cent interest, bookkeepers, capitalists and commercial agents, are all mentioned in Babylonian records of 2500 B.C. From these activities, dating back over four thousand years, our present-day office occupations evolved.

For centuries clerical work was of minor importance in the business world. Few clerks were needed when direct contact between producer and consumer or employer and worker was possible. Many merchants kept their records in their heads or used only simple bookkeeping records.

A systematic form of record-keeping became imperative and an ever-increasing number of office clerks was required as the Industrial Revolution introduced machines which greatly increased factory production. Improvement in office methods, however, lagged far behind factory-production methods.

The invention of the office typewriter was a promise of things to come. The first recorded attempt to invent a machine for writing letters appears in the British patent office records in 1714. Most of the early inventors were interested in perfecting a machine for use by the blind, using the principle of embossed characters.

More than a century and a half elapsed before a machine, easily recognizable as the forerunner of the present-day office typewriter, was put on the market. In 1874, E. Remington and Sons, an

American gunmaking firm, obtained a contract from Sholes and Glidden, inventors, to manufacture a machine later known as the Remington typewriter. Four hundred machines were sold that first year. The Underwood Company was one of the pioneers of the typewriter in Canada. The first one was probably brought into Canada from the United States in 1885.

Modifications and improvements in the typewriter led to other office machines such as bookkeeping and tabulating machines. The application of electric power to these machines was a great step forward in the evolution of office equipment.

The introduction of the typewriter created a need for operators, but prior to 1900 touch typewriting was practised only by operators of exceptional skill. Eventually special classes of instruction to teach touch typewriting began to appear.

Modern commercial schools had their early beginnings in efforts such as that of the Y.W.C.A. of New York which, in 1881, offered a course in typewriting—eight young ladies applied and took six months training.

Two important changes are thus attributed to the typewriter. The educational curriculum has been expanded to include commercial courses, and the doors of the business world were opened to women. Office work has since become a major field of employment for women. Many office machines today have a typewriter keyboard and most employers assume that prospective office employees have some typing knowledge.

Within the last decade dramatic advances have been made, and we now stand on the threshold of the electronic age in office equipment. The enormous strides made in office procedure are a response to a demand by businessmen for greater efficiency in clerical work. The new office machinery speeds up many routine office procedures and also makes it possible to obtain valuable reports which until now were considered too costly and time-consuming.

In an age of scientific management, the office assumes an important role as a directive and controlling force in commerce and production. Even simple office tasks require a greater degree of responsibility when a small error in original data is magnified through endless repetition by a machine which can perform thousands of calculations per minute. With more widespread use

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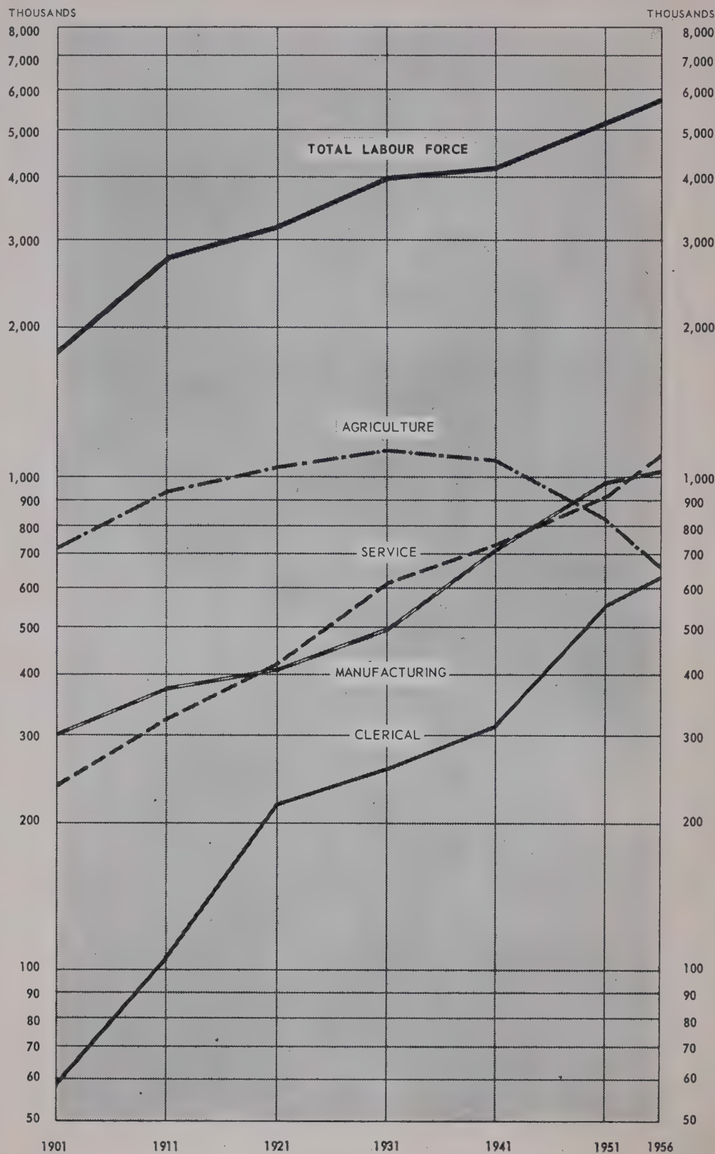
Chart 1

LABOUR FORCE IN SELECTED OCCUPATIONAL GROUPS
CANADA, 1901 – 1956



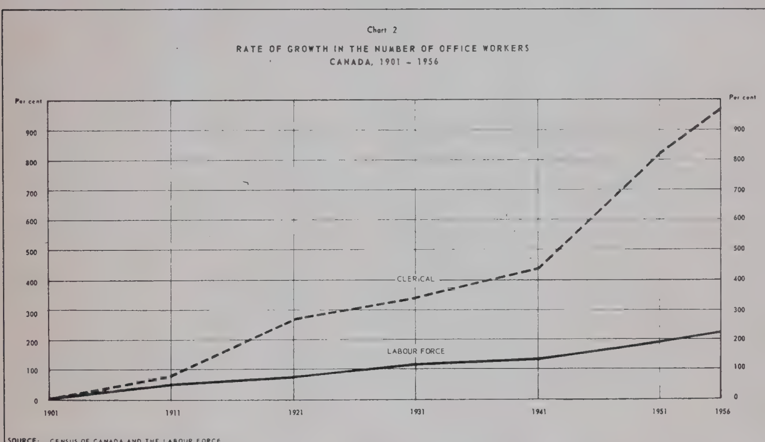
SOURCE: CENSUS OF CANADA AND THE LABOUR FORCE

Semilogarithmic scale

of such equipment, office workers will be relieved of much repetitive work and expected to use their human talents to better advantage in more advanced clerical work.

TRENDS [1]

Office work has become a rapidly growing field of employment in Canada. The number of clerical workers increased from 259 thousand in 1931 to 542 thousand in 1951. An estimate for 1956 places the number at 630 thousand. (See Chart 1.) This tremendous rate of growth is evident in Chart 2 and represents an increase of 972 per cent since 1901, compared with one of only 222 per cent in the total labour force! In 1931, seven per cent of the labour force were clerical workers; by 1951, the figure had risen to ten per cent.



Several developments contributed to this substantial increase in the proportion of office workers. First, factory production multiplied tremendously because of improved work methods and machinery and, as a result, created a need for more record keeping and correspondence. Increased factory production meant expanding trade which, in turn, needed a high proportion of clerical workers. Greater production and trade needed more or larger financial institutions to handle such things as stocks, bonds, insurance, and money. In addition, various social security measures

[1] Source: *Census of Canada* and *The Labour Force*

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such as family allowances, old-age pensions, unemployment insurance, and prepaid hospitalization plans have been introduced since 1940, all of which require vast systems of record keeping and other clerical work.

The Changing Composition of the Office Work Force

The influx of women into office employment, which started with the advent of the typewriter, has continued apace ever since. Up until 1941, men outnumbered women in clerical work, but since World War II, the balance has changed, and the 1951 census revealed that, for the first time, there were slightly more women than men in clerical work.

During the War, the Armed Services and war industries absorbed most of the available manpower; women answered the call for clerical workers and, having found office employment well suited for their particular needs, have chosen to remain.

Married women in clerical work have also increased greatly in number. In 1941 about eight per cent of the women in office work were married; by 1951, only ten years later, the number had increased to twenty-five per cent. Labour-saving devices in the home and a need for more clerical workers have encouraged a greater number of women to continue working after marriage or return to office work after a more or less prolonged period devoted to rearing a family.

Stenographers and Typists

The number of stenographers and typists has more than doubled from 69 thousand in 1931 to 139 thousand in 1951, of whom 96 per cent are women. Major cities continually report scarcities of competent stenographers and some employers have solved this problem by employing better-than-average typists to transcribe from dictating-machine records. Wherever qualified stenographers are available, however, typists are unlikely to displace them.

Office Machine Operators

The number of office machines with typewriter keyboards continues to grow, so that capable typists are quickly absorbed into the clerical force and aspiring office employees soon discover that a knowledge of typing is rapidly becoming indispensable. The comparatively recent, but rapid, increase in office mechanization

is apparent in census figures on office appliance operators. The number has grown to 11 thousand in 1951 from only 3 thousand in 1941, representing an increase of 267 per cent over a ten-year period. This upward trend is likely to continue although the rate of increase may diminish as more multi-purpose machines appear on the market.

Office Clerks

In the Census of Canada, all office workers not elsewhere classified are designated as "office clerks". *These account for almost half the total clerical labour force* and include such diverse occupations as file clerk, statistical clerk, receptionist, payroll clerk and order clerk, to mention but a few. The total of this group for 1931 was 120 thousand, 76 per cent of them men. In 1951, of a total of 276 thousand, 57 per cent were men.

Outlook

Although there has been a continuous increase in the number of female office workers until they now outnumber the men, recent changes in office layout and equipment may attract more young men to clerical occupations than formerly.

A new office world is in the making, with electronic computers and data-processing equipment, discs and tapes, necessitating a different view of office organization. Some routine repetitive jobs, and even the division between departments, may disappear in large offices, but occupations like those of stenographer, typist and receptionist and the work methods in many small offices will remain relatively unchanged.

OFFICE ORGANIZATION

Structurally, office organization is like a pyramid. At the top is a manager, director, or president, in general control. Reporting directly to the manager are department managers each responsible for general direction and control of a segment of the office staff. Department managers, in turn, have a number of section supervisors each directly responsible for the work of a segment of the office workers within the department. The base of the pyramid may include hundreds of rank-and-file clerical workers.

The extent of systematic and rigid organization of employees depends largely on the type of business, number of employees and amount of mechanization and integration of clerical functions. Very small offices with one or two employees obviously do not require an organizational chart to determine work division.

The offices of doctors, lawyers, business agents and many others operating on an individual basis are typical small offices. One person often acts as receptionist, secretary-stenographer and bookkeeping clerk. Office machines are usually limited to a typewriter and an adding machine.

In establishments where there is a considerable volume of clerical work, as in head offices of insurance companies and banks, and in offices of large manufacturing concerns, the office staff is numerous and division of work and departmentalization occur. For example, one may find a personnel department responsible for employment and welfare of employees, an accounting department to handle financial matters, and purchasing and sales departments for the buying and selling. Departmentalization tends to increase with each increase in the size of the organization.

Chart 3 is a simplified picture of a large company showing a division into five main departments. Charts 3a and 3b give a departmental breakdown. Each section may be regarded as an almost self-contained office within the larger structure. For example, the credits and collections section under the direction of an official may include stenographers, typists, various bookkeeping clerks and machine operators. The medical unit, on the other hand, is often relatively small. It may resemble a doctor's office in private practice, and have only one clerical employee, a receptionist-stenographer, working for the doctor.

Where a group of office workers is engaged in the same occupation within a company, different degrees of knowledge, responsibility and experience may be designated by the terms *junior, intermediate* and *senior*. Although one normally finds young employees in the junior category and the older ones in the senior, age is not a criterion for the designation. All beginners must expect to start as juniors and, with increased responsibility and experience, progress to intermediate and senior levels. Experienced workers may be hired at higher levels. In small offices, where there are relatively few employees, these categories are not used.

CHART 3—BASIC FUNCTIONAL ORGANIZATION STRUCTURE

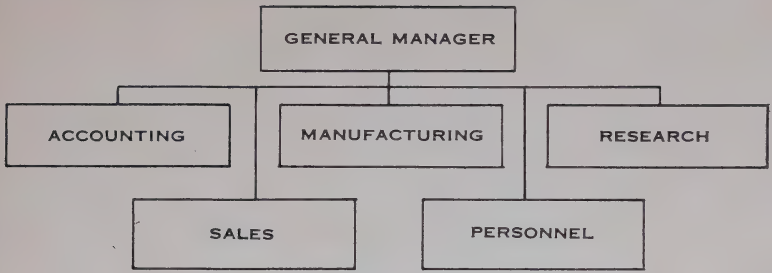


CHART 3 a. DEPARTMENTAL FUNCTIONAL ORGANIZATION—ACCOUNTING DEPARTMENT

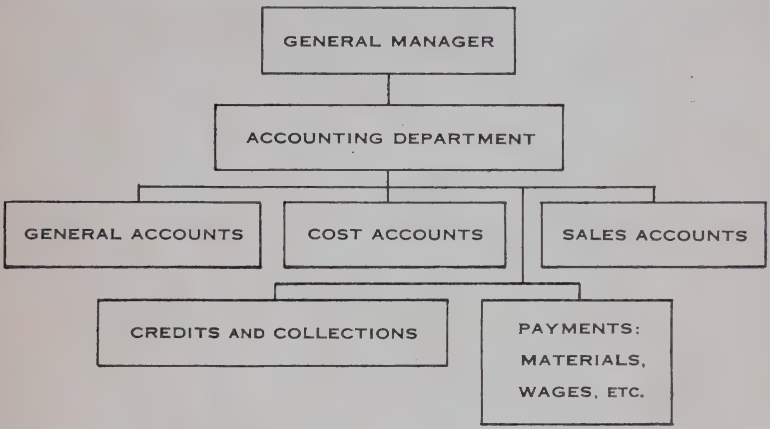
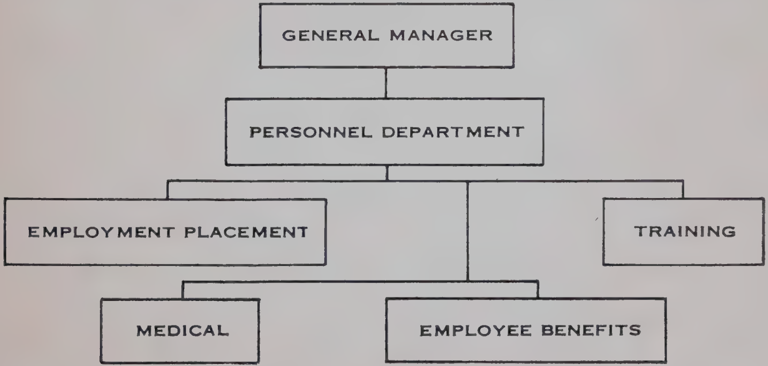


CHART 3 b. DEPARTMENTAL FUNCTIONAL ORGANIZATION—PERSONNEL DEPARTMENT



In many offices some positions are merely classified as senior clerk, intermediate clerk and junior clerk. These are general classifications which may be ideal for payroll purposes but give no indication of the type of work performed, which may range from office boy to bookkeeper.

EDUCATION AND TRAINING

Clerical workers need and obtain a higher level of education than most other non-professional workers. According to the 1951 Census, 76 per cent of the men and 91 per cent of the women clerical workers had nine years of schooling or better (see table below). A general requirement is a sound knowledge of grammar, spelling and arithmetic. An office worker's chances of advancement depend on the amount of basic academic education obtained, and today high school graduation is often a minimum educational requirement in companies which have planned methods of employee promotion.

In a large portion of Canada, English is the only language required, but there are many French-speaking communities in the Province of Quebec where business is conducted in French and in which French is the required language. The existence of

Number and Percentage of Workers with at least 9 Years of Schooling or Better

Sex	Total Number of Workers in Group	Nine Years of Schooling or Better	Percentage
All Occupations			
Male	4,121,823	1,854,383	45
Female	1,164,321	768,782	66
Manufacturing			
Male	668,956	289,239	43
Female	172,412	65,057	38
Clerical			
Male	243,900	185,390	76
Female	321,809	291,490	91

Source: *Census of Canada.*

these two official languages in Canada creates a need for bilingualism in an increasing number of occupations, particularly in large business centres, such as Montreal, and in some government positions. Other languages are of minor importance but may be necessary in import-export firms who do business with foreign countries.

Instruction and practice in many office skills may be obtained through high school courses and on the job. Operation of specialized office machines, such as the bookkeeping machine or the calculator, is usually taught at training centres established by makers of the machines or in business colleges. The centres are operated on a fee basis, as are business colleges, and issue certificates of competency on successful completion of a course.

The most common business courses are in bookkeeping and stenography. They may vary in scope from a course of six months which is limited to the acquisition of a minimum knowledge of the subject, to a post-high school course of three years such as the secretarial course offered in the Ryerson Institute of Technology in Toronto. A three-year correspondence course to enable secretaries to broaden their knowledge and qualify as "Administrative Assistants" is provided by the Association of Administrative Assistants, in conjunction with the University of Toronto.

Recognition as a Certified Professional Secretary is given through a six-part, twelve-hour examination sponsored by the National Secretaries Association (International) and administered through one of its departments, the Institute for Certifying Secretaries. This examination takes into account knowledge and judgment gained through actual job performance as a secretary and requires a work experience varying from three to eight years, depending on formal educational background. The examination is held once a year in May at approved testing centres.

Bookkeeping studies may be continued to professional level at university and lead to a bachelor of commerce degree with specialization in accountancy. Some universities such as Western and Acadia, and Waterloo College, offer specialization in secretarial practice in courses which may be credited toward a bachelor of arts degree.

Evening and correspondence courses[1] are other ways of acquiring office skills. Employees who feel the need for further education

[1] Queen's Printer, *Canadian Vocational Correspondence Courses* (Ottawa, 1959).

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may enroll for a business course, evening high school, or even university studies. However, hard work, ambition and perseverance are essential to success in studies which are pursued after a person's normal work day.

PERSONAL QUALITIES NEEDED

Because of the great diversity in office functions it is possible for many different types of people to find office work that is suitable to their temperament. Some office duties require special personal qualities; for example, the duties of receptionists and order clerks demand qualities that enable them to deal effectively with the public, but the duties of, say, the duplicating machine operator, place much less emphasis on such qualities.

The "typical" office worker, if one can be imagined, is expected to be reasonably well-groomed, courteous and tactful; willing to co-operate and do a share of extra work that often occurs. The ability to concentrate amid noise and distraction, and a good memory for details, are valuable assets. Rush periods, heavy responsibility and other emergencies, call for emotional stability. Some office work, especially in small offices where only a few persons do all the clerical work, requires considerable initiative and versatility.

Office work—much of it sedentary, and generally classified as having light physical demands—is an important source of employment for many physically handicapped people, if they have the necessary educational background or training. The usual care in matching a person's remaining abilities with the physical requirements of the position must, of course, be observed. Demands for eye-hand co-ordination, finger dexterity, and the ability to move about, vary widely in office jobs.

There are a number of standardized tests that purport to measure what is called clerical interest and aptitude. In the hands of qualified counsellors, such tests may be useful in helping to determine one's suitability for office work.

There is no particular minimum age limit for entry into office work, other than that imposed by provincial law or the demand of the work for maturity and experience. Many persons have started business careers at an early age, working up with experience and self-improvement.

In small offices employees need initiative and versatility

ENTRY

The shortage of qualified clerical workers, and the fact that office help is required in all communities where business is conducted, makes it relatively easy for those with adequate education and training to locate opportunities for office employment without going too far afield.

In planning a systematic job-seeking program, prospective office workers may use a variety of sources of information. The National Employment Service, with offices in all principal Canadian centres, brings together the employer seeking help and the applicant looking for work, and offers a counselling service to young people who are seeking their first jobs.

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Job seekers may also find useful leads in the employment columns of daily newspapers, or they may apply directly to likely employers without reference to any particular vacancy.

Students who are on the point of graduation from a business course or high school may find, on inquiry, that the school has a list of employers interested in obtaining clerical workers.

Applicants for clerical positions are usually requested to fill out application forms, particularly in large business firms. The neatness with which this is done may be taken by the employer as an indication of the quality of work to be expected from the applicant—an important point to be remembered by the prospective office worker.

It is also quite common for employers to screen job applicants, using one or more tests of clerical aptitude and proficiency. Applicants for clerical work should, therefore, be prepared to be tested during the hiring process.

Governments at all levels are extensive users of clerical help. Hiring for positions in the federal government is done by the Civil Service Commission through competitive examinations that are held in principal centres throughout Canada. Information on job opportunities may be obtained from posters displayed on public notice boards in Post Offices, and offices of the National Employment Service and the Civil Service Commission. Notices of competitions are also published in the *Canada Gazette*. Applicants, as a rule, are expected to have at least five years residence in Canada and must possess the minimum qualifications for the position advertised.

WORKING CONDITIONS

The nature of office work is such that good physical working conditions are easily attainable. Proper ventilation and good lighting are taken for granted but, in a rapidly expanding business, office staff may, at times, be crowded.

Salaries

Salaries paid in specific office occupations are to be found in sections dealing with those occupations. Education and training have a direct bearing on the salary a beginner may expect. Clerical workers are generally paid weekly or semi-monthly.

Hours of Work

The $37\frac{1}{2}$-hour week is the most common, and office hours are from 8:30 or 9:00 a.m. to 5:00 or 5:30 p.m. with one hour for lunch, five days per week. A period of ten to fifteen minutes for a coffee break morning and afternoon has become an established custom.

Time off during the week is the usual arrangement when Saturday work is necessary—employees, as a rule, take turns on duty if the office must remain open every Saturday. Accounting staff may be obliged to work overtime as the end of an accounting period approaches; some employees may be obliged to reach a daily balance before leaving for the night.

As a rule, a vacation of two weeks with pay is granted after one year of service, and three weeks after 15 years. Some firms grant four weeks after 25 years service. There are also approximately eight statutory holidays.

Employee Welfare

Pension plans in which the employer pays at least 50 per cent of the premium, and group life and hospitalization insurance, exist in most large companies.

A first-aid room with a nurse or first-aid attendant on duty is often provided and in some large companies, employees may even receive treatment prescribed by their own doctor, such as injections or heat-lamp treatments. Sick leave without a medical certificate or loss of pay is the rule provided that such absences do not occur too frequently.

Many companies have cafeterias where meals are available to employees at cost.

ORGANIZATIONS

According to an article in the January 1953 issue of *The Labour Gazette,* it is only in the last fifteen years that any significant number of office workers have become organized. "The slowness of office workers [in the manufacturing industry] to organize, in comparison with plant workers, can be attributed to a number of factors, most of which are not peculiar to manufacturing but apply to industry generally.

"Fifty years ago, office workers generally commanded substantially better working conditions than production employees. Clerical staffs were small and, as a rule, closely associated with management, a situation which not only contributed to better working conditions for the white-collar group but made them feel more closely identified with management than with labour.

"Developments of the past half century, however, have changed the conditions of office work. As industrial units have expanded, office staffs have grown larger and many clerical jobs have become routine and mechanical in nature. At the same time, non-office workers have made rapid gains in employment conditions, and many of the advantages formerly associated with office employees now apply equally to plant workers. During the past 10 or 15 years clerical employees have undoubtedly become more receptive than previously to unionization.

"One obstacle to the unionization of white-collar workers is the high proportion of women doing office work. Since many women regard their employment as temporary, they often show little response to the long-range goals of unions".

For reasons given above, the majority of office workers are not organized. Those who are may belong either to unions composed solely of office workers, or to unions drawing members from both office and non-office workers in a plant or industry. The Office Employes International Union, drawing membership largely from the pulp and paper industry, and the American Newspaper Guild, are examples of office worker unions. Production worker unions covering office and non-office workers in some plants include the International Association of Machinists, United Automobile Workers, United Steelworkers of America, International Union of Electrical, Radio and Machine Workers, and others. There are, in addition, a number of employee associations, and mixed plant and office worker bargaining units.

Many office workers are employed by municipal, provincial and federal governments, in which case they may be represented by civic employee unions or civil service organizations.

Among office workers, secretaries appear to be most active in attempts to organize as an occupational group. The National Secretaries Association and the Association of Administrative Assistants are each working toward recognition of professionally qualified secretaries.

The National Office Managers Association represents the main employer organization. It is concerned with research and exchange of information regarding methods, personnel, and other aspects of office management.

THE MAJOR GROUPS OF OFFICE WORKERS

Office work consists of a wide variety of clerical duties. These duties may be grouped according to similarity of the work, training and personality required. Thus, the *secretarial* group is primarily concerned with typing and correspondence. The *public contact* group, as the name implies, have duties in which they deal more or less directly with the public. *Records and processing clerks* handle and process correspondence and records other than financial data. The *accounting* group is occupied mainly with recording and analysing financial data. The mechanization of many office procedures has created other groups of increasing importance concerned with the operation of a wide variety of mechanical office equipment. Each group is dealt with separately.

This monograph deals only with non-professional occupations of a purely clerical nature that are found in offices. It does not cover executive, professional, technical or other groups that work in or from offices in a non-clerical capacity, except to indicate working relationships which exist.

THE SECRETARIAL GROUP

Much office work is concerned with correspondence and other written communication. This is usually typewritten and the text is often dictated to a stenographer or, by means of a dictating-machine, to a typist. When the subject matter is of a confidential or personal nature it is usually entrusted to a secretary.

The secretarial group includes: *secretary, stenographer, dictating-machine operator,* and *typist*. These workers should have a good command of language with special emphasis on grammar and spelling.

Secretary

The word "secretary" is derived from the Latin *secretum* meaning "one entrusted with a secret", indicating that the chief function of a private secretary is to be a *confidential* assistant to the employer. A good secretary always places the employer's interests first and by resourcefulness and good judgment, relieves him of many routine duties.

Secretarial work—a continuous process of learning and development

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Duties

The secretary reads all incoming correspondence addressed to her employer and determines which letters must be brought to his attention; the others she answers herself or refers to someone else for reply. Acting on her own initiative and on general instructions, she writes letters to suit her employer and may often dictate to a stenographer. She deals tactfully with office visitors and, if necessary, arranges appointments for them to see her employer.

A good secretary should be able to prepare material for reports and speeches, take shorthand notes and type rapidly. Very often she has to look after files in which are kept all the material to which her employer most frequently refers. She also files personal and confidential correspondence. When her employer must travel, she usually makes arrangements for his transportation and hotel reservations. In brief, the ideal secretary does everything possible to save her employer's time and energy for executive matters.

She is a person who stands between an executive and many minor irritations and routine interruptions. In order to assume responsibility for independent decisions she requires initiative and good judgment as well as proper training and background. In directing to lesser officials people who may have originally expected her employer's attention, the secretary needs tact and an understanding of human nature.

Above all, a secretary should have discretion, loyalty and a sense of responsibility, as she will be the recipient of much confidential information. She must not only keep this information to herself but refrain from hinting to friends about the secrets she knows. In addition, she should have the attributes of a first-class stenographer.

Education and Training

High schools, business colleges and some universities offer courses in secretarial practice. The duration of the course varies from one to four years depending on the type of education being offered. For example, a high school or business college may give a course of one year of intensive training in business correspondence, office practice, shorthand and typing. Ryerson Institute of Technology has a three-year course, open to senior high school graduates, which includes other related subjects useful to a first-

class secretary. At university one may specialize in secretarial practice while working toward a bachelor of arts degree.

Working Conditions

The private secretary may work in the same office as her employer, or may have a separate office of her own or shared with another. She is seldom expected to work in the large outer office.

Salary[1]

In 1958, the average weekly salary for female private secretaries was \$72; the predominant range of weekly salaries, from \$60 to \$90. There are no available figures for male private secretaries.

Advancement

A new employee seldom enters a company as a private secretary—at least two years experience with the company as a stenographer is usually a prerequisite. An executive often selects one of the more competent stenographers to be his secretary.

Private secretary is considered a terminal job in the line of promotion from typist, dictating-machine operator or stenographer to secretary, and some will be satisfied to have reached this goal. There are various class distinctions among secretaries, however, and the secretary to a vice-president or president of a company is on a much higher plane than the secretary to a junior executive. A continuous process of learning and development is essential in order to reach the higher levels, but it is a distinctly rewarding experience to work with a person who is at the pinnacle of success.

On rare occasions, a secretary may advance by obtaining the position of her superior when he moves to another job or retires; another may transfer to a position, within the company, which allows more scope for executive ability. The ambitious secretary can prepare for promotion by taking courses in such subjects as business organization, economics and commercial law.

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[1] Unless otherwise stated, salaries are derived from a survey of four major Canadian cities as reported in the 1958 *Wage Rates and Hours of Labour*, Economics and Research Branch, Department of Labour. They are presented in condensed form and reflect salary conditions in October 1958. Current information on local salaries and working conditions are available from National Employment Service offices and local employers' associations.

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Stenographer

The word "stenography" is derived from the Greek words *stenos* and *graphia*, which mean a short method of writing. Stenography dates from the year 1837 when the Pitman system of shorthand was introduced; the Gregg system followed in 1888.

...quick and accurate in shorthand and typing

Duties

A stenographer writes the dictation of correspondence, reports, and other matter in shorthand, then transcribes and types the dictated material. A knowledge of technical language or terms used in particular professions may sometimes be required.

Other duties are to see that enclosures are attached to letters and , when necessary, tactfully remind her employer of information which he may have promised to supply to his correspondent.

Very often a stenographer must also maintain files and records, type forms, prepare stencils and use a duplicating machine. She may take and transcribe minutes of meetings, and handle routine correspondence. On occasion, she may replace an absent secretary.

To be successful, a stenographer must be quick and accurate in shorthand, typing and spelling. As she often works in a large

office, she should be able to concentrate in the midst of distractions. She needs a good memory for details and tact in dealing with others. The stenographer may often have private information about the firm for which she works and must, therefore, be discreet in discussing her work with others.

Education and Training

Complete high school education is desirable, but Grade 10 or Grade 11 is often accepted as suitable educational background.

Proficiency in typing and shorthand is expected of a stenographer. Shorthand speeds of 100 to 120 words per minute and typing speeds of 50 to 60 words per minute are the usual standards set by commercial schools and business colleges for their graduates. However, speeds of 60 and 30 respectively are often accepted by employers hard-pressed for stenographic help.

Working Conditions

Stenographers usually work in the general office area, frequently moving to private offices to take dictation. The noise and distraction of other office workers and office machines is usually present. In large offices, beginner-stenographers may start in a stenographic pool where they, among many others, will be available on call for a variety of stenographic duties throughout the firm. Appointment to a specific department may be made at a later date when they have acquired sufficient experience.

Salary

In 1958, the average weekly salary for junior female stenographers was $53. Senior female stenographers received $61. The predominant range of weekly salaries for juniors was $45 to $65; for seniors, $50 to $75.

Advancement

Most stenographic positions are filled from outside the company, but an office clerk who qualifies by completing the necessary stenographic course is almost immediately promoted to a stenographic position. The line of advancement for stenographers in large companies is through established grades by which they may progress from junior stenographer to intermediate, to senior stenographer and, at times, to secretary.

The stenographer who is competent in her work and has given some indication of leadership qualities may become head of a stenographic pool. Her duties then would be to see that the work is properly divided among the stenographers, read finished material, make any necessary corrections, be responsible for the general order and efficiency of the section, and coach junior employees. She would also be expected to keep a record and make reports on the work done by each stenographer in her section.

The ability to perform the duties of *legal stenographer, medical stenographer* and other stenographic positions where technical terms are used is usually the result of some experience and familiarity with the terminology.

A stenographer with a good background of experience and knowledge, if living in a large city, may go into business for herself as a public stenographer, establishing her office either in or near a large hotel to get the travelling trade. Public stenographers usually charge by the page or folio, and work for clients who need temporary stenographic services.

Expert stenographers may become verbatim reporters whose duties are to transcribe exact reports of proceedings at important conferences, association meetings, in court and in parliament. Travelling, with all expenses paid, is sometimes part of the job.

Typist, Dictating-machine Operator

The invention of the typewriter has had far-reaching effects not only on office occupations but also on the composition of the office staff. It opened the doors of the business world to women and today 96 per cent of all stenographers and typists are female.

The dictating-machine operator is included in this section because typing is required for the transcription of dictated material. *Vari-typists, teletypists* and *automatic-typewriter operators* are mentioned for similar reasons.

The dictating machine, or dictaphone, is a phonographic machine which records material, dictated by means of a microphone, for transcription by a typist. The vari-typer resembles a long-carriage typewriter and has easily changeable type of various styles and sizes. The teletype machine is part of a communication system, and has a keyboard which is electrically connected to another machine of the same type at a distant receiving or sending point. The automatic typewriter has a standard keyboard and a small panel of push buttons. The buttons are for the selection of paragraphs in constructing and automatically typing the bodies of routine letters, or for setting up complete pages of material to be copied.

Duties

The *typist* makes typewritten and carbon copies of manuscripts, letters and records from original material, rough drafts or corrected copy. She should be able to note and question any grammatical errors or ambiguous expressions in the work she is given to copy. The typist also addresses envelopes, fills in report forms and index cards, and prepares stencils from which copies are made on a duplicating machine. She may often be required to type statistical material, which involves a knowledge of tabular spacing.

The *dictating-machine operator* transcribes messages reproduced in sound from wax records, discs, magnetic tapes or wires on a dictating or transcribing machine. She regulates the speed and tone of voice by manipulating the controls, and types verbal material as heard in the earphones. She may type other information which is not recorded, such as name, date and address or other identifying information, and maintain a file of records.

The vari-typist's finished work resembles printed material

The *vari-typist* types letters and prepares master copies, such as stencils and tracings, on a vari-typer—a machine which produces copy with a printed appearance. The operator selects suitable size and style of type and adjusts the machine to obtain the proper spacing and even right-hand margins. Aside from the basic job of typing copy, the vari-typist may perform related art work, such as adding headings and creating decorative page effects.

The *teletypist* sends and receives messages to and from various distant points. By striking the letters of the keyboard at the sending point, the operator activates a similar machine which types the message at the receiving point. It may be necessary to keep a record of the messages.

The *automatic-typewriter operator* frequently operates two types of machines, each with a typewriter key-board. One machine is for typing matter which is reproduced in the form of perforations on a roll of paper similar to a player-piano roll. The other machine, in use more often, is for making copies by means of a mechanism that resembles that of a player piano. This machine is almost fully automatic, but the typist must type in names and addresses or

other information which change with each copy. She often operates several of these machines at a time. Automatic typewriters are still relatively new in Canada.

Education and Training

For the simplest typing duties, one or two years of high school with a good knowledge of grammar and spelling is essential. Employers expect beginners to have a minimum typing speed of forty words per minute but may accept thirty. Dictaphone, varitype, teletype and automatic-typewriter operation is usually taught on the job, but typing skill is necessary.

Working Conditions

A typist may work in a small office, with two or three other employees, as a clerk-typist performing many clerical jobs as well as typing miscellaneous matter. She may work in a department of a larger office where she is the only typist, or in a still larger office where she will be one of many typists doing similar work.

Office skills may be improved in evening classes

Salary

In 1958, the average weekly salary for junior female typists in four major Canadian cities was $46; senior female typists received $54. The predominant range of weekly salaries for juniors was $35 to $55; seniors, $45 to $65.

There are no available figures for male typists.

Advancement

Positions as typist or clerk-typist are often immediately available to junior company employees who take a typing course and acquire sufficient speed and proficiency. Typists in large companies may advance from junior, to intermediate, to senior typist, and at times to dictaphone operator.

The opportunity to learn the operation of the automatic typewriter, the vari-typer, teletype and many key-punch and accounting machines which have typewriter keyboards is a form of advancement. A typist may often obtain on-the-job training on one of these machines, or she may be sent by her employer to the machine supplier for special training. This extra skill and responsibility usually leads to a salary increase. Shorthand (for those who wish to become stenographers) and the operation of some office machines are not taught on the job, but require special training.

THE PUBLIC CONTACT GROUP

Business firms realize the importance of building and maintaining customer good-will and select some employees with this thought uppermost. These workers form the public contact group which includes *receptionist, order clerk* and *telephone operator*. They speak to customers face-to-face or by telephone and may, by their general conduct, create and maintain good public relations that are highly valued in the modern business world.

Receptionist

The occupation of receptionist was introduced to office occupations with the growth of large offices. Subdivision of work, with everyone busily engaged in performing his or her own task, demanded that someone be appointed to receive and direct callers.

Duties

The receptionist is the first office employee seen by visitors and should create an immediate impression of courtesy, efficiency and mental alertness. She receives all persons who come to the office, tactfully ascertains the purpose of the visit, and directs them to the appropriate person. Thus higher officials of the company are spared time-consuming routine interviews without loss of customer good-will.

Many companies expect the receptionist to keep a record of the name of each caller, the time of the call, the nature of the business and the person seen. Statistics compiled from this information are sometimes required.

As receptionists are seldom continually busy receiving and directing callers, they usually have other duties which can be put aside at a moment's notice. Some of these are: typing index cards, addressing envelopes, and filing.

Education and Training

Receptionists should have at least one or two years of high school. Neat, legible handwriting, and an elementary knowledge of typewriting and bookkeeping are an advantage.

Working Conditions

A receptionist, dealing with the public and subject to frequent interruptions in secondary tasks, can expect very little

privacy in her work. She must, moreover, be constantly in the immediate vicinity of her desk or find someone to replace her temporarily.

Salary

Salaries vary considerably according to the range of duties performed. This is, on the whole, not a highly paid occupation, because there is little specific training involved.

Advancement

The position of receptionist is usually acquired through promotion from one of the junior grades in a company, or transfer from another at the same level. Because it calls for a knowledge of company policy and organization, it often requires a few months experience with the company in another capacity. Additional office skills are difficult to learn in this job, and promotion often depends on knowledge acquired through extra courses of study.

At times, a company employee with the necessary qualifications is transferred to this position for health reasons. Sometimes office employees nearing retirement age are transferred to receptionist duties to relieve them of responsibility which may have become too heavy a burden.

Order Clerk

The survey of wage rates and hours of labour previously mentioned includes 1,108 male and 419 female order clerks, roughly a ratio of five to two. In all preceding occupations female workers have predominated.

Duties

Order clerks receive orders for merchandise by mail, telephone, or directly from customers. The clerk completes an itemized order form, adding the stock code number for each item and, depending on company policy, may include prices and extensions.

They may check with the credit department to determine the risk involved in extending credit to customers, and are responsible for cash and cheques received with orders. They record money received and pass it to the cashier at the end of each day.

Files of all orders received must be maintained, and a follow-up made on any order for which a shipping invoice has not been

received. (Receipt of the shipping invoice indicates that the merchandise has been shipped to the customer.) Order clerks also check shipping invoices with the original orders for errors.

The above sequence of duties may be performed by one person or divided among several. The amount of responsibility placed on an order clerk determines the avenues of advancement and the salary.

Education and Training

The requirements for ordinary order clerks are similar to those for receptionists. Some order clerks must also have high school completion in science, or technical training, in order to understand the terminology used in advanced and higher-paid jobs.

Working Conditions

Order clerks often experience rush periods when there are many people placing orders, inquiring about delivery or making complaints. Despite all this, they must keep up with the paper work involved in processing orders. They must also deal graciously with all types of customers, including the impatient, the undecided, and the very rude.

Salary

In 1958, male order clerks received an average weekly salary of $72, with a predominant range of $50 to $95. Female order clerks received an average of $53, with a predominant range of $40 to $70.

Advancement

The position of order clerk may be a promotion from one of the junior grades, or it may be a phase of a regular training scheme for promising young employees. This is one part of a business that future executives are usually expected to learn.

A mail-order clerk may become a posting clerk in the accounting department with a chance to learn bookkeeping.

Order clerks whose duties are on a higher level and who have sufficient education may eventually go far in the company. They are receiving valuable training and experience in public contact work which can lead to opportunities in the sales, purchasing, industrial relations, or personnel departments.

Telephone Operator

In business today, much attention is paid to the "voice" on the line and what it can accomplish in terms of good public relations. The office switchboard-telephone operator is, therefore, chosen with care.

Duties

The telephone operator relays incoming, outgoing and inter-office calls through a telephone switchboard, and may supply information to callers or take messages.

She records the details of all incoming and outgoing long-distance calls chargeable to the company. She may check telephone bills to verify the long-distance charges, and send the bills with record forms attached to the accounting department.

She is frequently expected to do some typing during slack periods on the board. If the board is not a busy one, it may be placed in the front office, where the operator may also double as receptionist.

Education and Training

A minimum of two years high school is required, although junior matriculation or business school training is preferred.

The prospective operator may be sent by her employer to a telephone company P.B.X. (private branch exchange) training school for one full day of instruction, to be followed by further on-the-job training. The length and extent of the training will be determined by the type and size of the switchboard, the learning capacity of the individual and the additional duties required of her.

Working Conditions

The telephone operator must be at her post punctually and must not leave it until the last minute of work. She has regular rest periods, which may be more frequent than those of other office employees if the board is a very busy one.

Peak loads occur at certain periods of the day when all her time and attention must be devoted to the board. During quiet periods she may be expected to perform other duties such as typing or filing.

The telephone operator often works in the front office but where more than two regular operators are needed, the switchboard is usually in a separate room.

Telephone operators are usually taught on the job

Salary

The average weekly salary of office telephone-switchboard operators in 1958 was $52, with a range of $40 to $65.

Advancement

The position of telephone operator may be a promotion for a junior employee who has been acting as replacement on the board; others enter through regular employment channels. This work does not ordinarily lead to promotion unless additional skills are acquired. With extra academic studies, personnel and public relations are two areas where the operator's experience in dealing with the public would be an asset.

RECORDS AND PROCESSING CLERKS

Correspondence Clerk

Personnel Clerk

File Clerk

Mail Clerk

Office Boy or Girl

These occupational titles are grouped together because, to some extent, all are concerned with handling and processing correspondence and records, excluding financial data. They represent a wide range of responsibility and knowledge demanded of the workers. Correspondence clerks and personnel clerks usually require a good background of education and experience, but the positions of file clerk, mail clerk and office boy or girl, are generally recognized as entry jobs.

Correspondence clerks are needed in establishments where there is a considerable volume of mail which does not, as a rule, require action on the executive or managerial level. It may consist of requests for additional merchandise, for information on customer credit or on insurance and pension plans. It may be claims for incorrect billing of purchases, unsatisfactory service rendered, or lost or stolen merchandise.

These workers initiate action to comply with requests or make inquiries to obtain information, and write, draft or dictate replies. A considerable amount of judgment and a sound knowledge of grammar, spelling and composition are essential.

Employers usually seek persons with at least senior matriculation. Many insist on previous general office experience.

Personnel clerks are employed in large establishments to maintain employment records of the firm's staff. They prepare documents for new employees showing name, address, qualifications, rates of pay and other details, and keep them up to date. Days absent on vacation or because of sickness must be recorded.

Supervisors' reports on ability are filed in each individual's folder and, in case of termination of employment, the date and

cause. Personnel clerks may check references of new workers, or provide them for workers who leave.

At periodic intervals, personnel clerks may compile and type statistical and narrative reports from employment records.

This type of work requires mature individuals. Much personal information is entrusted to them that must be kept strictly confidential.

A typist or senior clerk may gravitate to this position. When an outsider is hired, it is usually on the basis of experience in the personnel field. It is an interesting opportunity for the employee who has a sincere interest in the welfare of others and may open the door to more advanced positions in public relations work or administrative positions in the personnel department.

File Clerks receive carbon copies, reports and documents of all kinds to be kept for future reference. This material must be classified alphabetically or numerically, by subject matter or by code number, so that it may be found without difficulty. A record is also kept of material removed from the files.

File clerks may be expected to review file contents periodically, check classification, and discard any obsolete material. They may also be expected to search for additional data to be included in reference files. The average file clerk is not expected to set up or re-organize a filing system.

The person who likes to have "a place for everything and everything in its place" and who has a sense of responsibility, average intelligence and judgment has the personal qualifications needed in this occupation. One or two years of high school with emphasis on spelling is the usual minimum educational requirement. Some large companies, however, with recognized lines of promotion within the company, prefer junior matriculation so that their file clerks may progress to higher clerical positions.

General academic schooling without specialization is sufficient, but a knowledge of typing is helpful as index cards for the material on file are often typed. No experience is required, as a rule, because this is an entry occupation.

Mail Clerks receive all incoming company mail, open and stamp the time of arrival on it, and sort it for distribution. They seal and stamp outgoing mail, weigh packages to decide correct amount of postage, and list registered mail.

Mail clerks may also distribute and collect mail, and operate different mail-room machines, such as a letter opener, a stamping machine and an envelope-sealing machine.

Honesty and a sense of responsibility are important personal attributes as money, bonds and confidential information may be sent through the mail. One or two years of high school is usually considered sufficient for the position and no special training is required.

Office Boys and Girls are known by many other titles. Banks have page girls, some offices have bench girls or boys, and some have messengers, but their duties are alike. These young people perform all the minor jobs in an office. They run messages inside and outside the office, deliver and collect mail within the office, help in the mail room and perform other simple duties as directed.

Office boys and girls are expected to be courteous and willing, have correct posture, and be neat, clean and wholesome in appearance. Seventh-grade schooling is usually considered acceptable for an office boy or girl but this is insufficient for advancement. The ambitious young person who is obliged to work may enquire about the possibility of free evening classes in school subjects at a local school.

Salaries

With the exception of file clerks, separate salary statistics are not available for this group of office workers. In 1958, average weekly salaries for female file clerks in the manufacturing industry were as follows: Montreal $43.35, Toronto $46.34, Winnipeg $36.87, Vancouver $43.25.

Because of the small number of male file clerks surveyed, no statistics were compiled for publication.

THE ACCOUNTING GROUP

The accounting department handles all the financial and statistical work of an establishment. Of the occupations in this department *bookkeeper, statistical clerk, payroll clerk* and *posting clerk* are selected because they are representative of the many occupations in this group.

Bookkeepers and payroll clerks work in all types and sizes of offices and their physical working conditions vary accordingly. Statistical clerks and posting clerks usually work in large offices and should be able to concentrate in the midst of distractions, such as noise from office machines and telephone conversations.

Bookkeeper

The bookkeeper heads the office accounting staff and is generally responsible for the work of the section. This position may be accorded the status of accountant when a combination of experience, volume of work and degree of responsibility warrants it.

Duties

Bookkeepers record all business transactions in a systematic manner. They examine data and enter it in the appropriate record books or on special forms. They balance the books at fixed intervals and prepare reports to show income, expenses, accounts receivable, accounts payable and any other financial transactions for the period. They may prepare the Statement of Profit and Loss, and the Balance Sheet.

In a large establishment, the bookkeeping may be divided among several bookkeepers, each responsible for only one section of the work, and under the direct control of one head bookkeeper or an accountant.

The bookkeeper in a small business may, in addition, calculate and distribute wages, type invoices and send out monthly statements to customers, and also have some stenographic duties.

Education and Training

High school completion is considered the minimum educational standard, followed by at least one, preferably two, years additional study in bookkeeping, or accounting, in business school or at university.

Salary

The average weekly salary for senior male bookkeepers in 1958 was $84, with a range of $65 to $110. Junior male bookkeepers received an average of $63, with a range of $45 to $85. For senior female bookkeepers, the average was $68, with a range of $55 to $85. Junior female bookkeepers received $53, with a range of $45 to $65.

Advancement

The position of bookkeeper is generally a promotion from one of the lower positions in the accounting department. It usually requires at least one year of bookkeeping experience in a junior capacity.

A bookkeeper may acquire the status of accountant within a company after years of experience, but official professional recognition is accorded through the various accountants' associations only after certain conditions have been met. Associations such as the Chartered Accountants, Certified General Accountants, and

the Registered Industrial Accountants have established professional standards, and prospective members must pass a set of written tests and prove that they have a specified number of years practical experience or apprenticeship with a chartered accountant.

Statistical Clerk

It is important for firms to have figures prepared and presented in report form on all phases of the business. Statistical clerks perform much of this work. They prepare and analyse special and regular reports on sales, production, the budget, special contract work, bad debts and other information of interest to management. The ability to grasp the elements of factory processes is necessary in compiling some statistics.

Figures contained in bookkeeping records are the basis for most statistical work. A calculating machine is usually necessary to figure percentages, index numbers and graphs, which are the most frequent methods of indicating trends.

Education and Training

High school completion, with emphasis on mathematics, is expected of statistical clerks. Some companies may prefer training in higher mathematics at university level if the work is complex.

Calculating machines are invariably used in this work but knowledge of machine operation is considered of secondary importance compared with a knowledge of percentage and decimal systems. Machine operation may be learned on the job.

Salary

No separate figures on salaries for statistical clerks are available.

Advancement

As a rule, statistical clerks are chosen from the company staff. Beginners are seldom considered unless they have some university training in statistical analysis.

The position of statistical clerk may be a promotion for a factory-office[1] clerk, or an employee in the accounting department who has shown exceptional ability with figures. It may be

[1] A factory or production office is a partitioned space on the factory floor where foremen and other supervisors perform the clerical work connected with their positions. They may allocate much of this work to a clerk who is chosen, if possible, from among the production workers.

an opportunity for a promotion from, or to, that of payroll clerk, depending on the relative degree of importance attached to each position.

Payroll Clerk

The Department of Labour survey of wage rates and hours of labour in Canada indicates twice as many female as male (873 to 385) payroll clerks in the manufacturing industry in 1958.

Duties

Payroll clerks calculate each worker's earnings, using information from attendance sheets, time cards, and production tickets. They post the calculated data on payroll forms, showing items such as the worker's name, gross earnings, deductions, and net wages.

Payroll clerks may use calculating machines, write pay cheques, and help in the distribution of pay envelopes. Honesty and accuracy are of prime importance in this occupation, although internal audit and cross-check systems will generally uncover wrong entries.

Education and Training

Third year high school with a one-year business course is the usual minimum educational requirement. A knowledge of typing and calculating-machine operation is often preferred, but may be learned on the job.

At least six months experience in the accounting department at a junior position may be necessary before an employee is capable of accepting the responsibility of payroll work. Courses on calculating-machine operation, which include intensive practice on payroll work, are a good preparation for this position.

Salary

The weekly average salary for male payroll clerks in 1958 was $69 with a range of $50 to $90. Female payroll clerks received $55 weekly average, with a range of $45 to $70.

Advancement

The position of payroll clerk may be a promotion from that of posting clerk or of some other job in the accounting department. It may also be an entry job for a trained calculating-machine operator.

Payroll clerks may find it difficult to move upward in the accounting department without further training. They may, of course, hope to become head of a payroll section in a large company, but such opportunities are not numerous.

Posting Clerk (Ledger Clerk)

The accounting department works as a team, with the staff relying on each other to do their share properly. Posting clerk is a minor position but mistakes or carelessness at this level may cause extra work for others.

Duties

Posting clerks make simple entries in ledgers or on special forms, taking the information from other accounting records. They total the columns of figures in the ledgers either daily or at regular intervals, and may use adding or calculating machines. They usually type the column headings on ledger sheets or special accounting forms.

Education and Training

At least two years high school is required of posting clerks. An additional one-year business course with emphasis on bookkeeping is preferred, although the ability to distinguish between a debit and a credit will often suffice for entry. An elementary knowledge of typing is an asset.

Salary

There are no separate statistics for posting clerks.

Advancement

Posting clerk may be an entry occupation or a promotion from one of the junior levels. Whenever a vacancy occurs, a file clerk, mail clerk or office boy or girl, who has the potential ability, may be promoted to the job.

This position may lead to a number of other accounting jobs, depending on the extent of the division of work. The posting clerk may move upward to bookkeeper in charge of accounts payable or accounts receivable and then to head bookkeeper.

Other opportunities for advancement occur when an employer decides to mechanize some bookkeeping operations. Training may be given on the job, or the clerk may be sent to the machine company for a short instruction period in machine operation.

ACCOUNTING MACHINE GROUP

The machine occupations which are most easily recognized as accounting or bookkeeping occupations are: *bookkeeping-machine operator, billing-machine operator* and *calculating-machine operator*.

This group of occupations has much in common and is, therefore, treated separately only where there is a significant difference, as in the description of duties and advancement.

Personal Qualifications

Hand and finger dexterity and good eye-hand co-ordination are of prime importance in these occupations. Good eyesight is needed. Accuracy and speed in working with figures and an aptness for spotting inconsistencies are necessary. Also needed are above-average clerical ability and a good memory for detail.

Education and Training

Two years of high school is usually required, with junior matriculation desirable. The student should acquire an elementary knowledge of bookkeeping and typing.

Business schools offer courses in office machine operation, and the machine manufacturers maintain training centres in the large cities across Canada.

Applicants for these courses may be given ability and aptitude tests to indicate their chances of success in the occupation of their choice. These tests may range from a short clerical test, including elementary arithmetic, to a bookkeeping questionnaire, an arithmetic test on a third-year high school level, and a mechanical aptitude test. Trainees may be on trial for a short initial period of the course. Reliable schools reject all unsuitable applicants after this initial try-out.

Instruction in many of these schools is on an individual basis; the duration of the course is, therefore, determined by the learning capacity of the student. Courses in bookkeeping- and billing-machine operation average four to five weeks of day classes or four to five months of evening classes. Calculating-machine courses may extend from nine to sixteen weeks in the day division or six to nine months in the evening. Fees range from $90 to $125 for the complete course.

Some employers give on-the-job training on these machines but such training is usually restricted to one phase of the machine work and does not turn out a qualified operator. On the other hand, qualified operators adapt easily to different makes of machines from the one on which they receive their initial training.

Entry

On successful completion of an office machine course, the student is given a diploma which, if it is from a reputable school, may open the door to many employment opportunities. The machine manufacturers' training centres have a placement service because of their contact with firms that use their machines.

Working Conditions

As a rule, these office machine operators work in a medium-sized or large accounting department with other bookkeeping clerks. A normal amount of noise and distraction is to be expected.

Salary

The average weekly salary for female bookkeeping-machine operators in 1958 was $56, with a range of $45 to $70.

That of female billing-machine operators was $52, with a range of $40 to $60.

Female calculating-machine operators received $53, the range was $40 to $65.

There are not enough male operators to warrant salary statistics.

Bookkeeping-Machine Operator

The bookkeeping-machine operator is able to take over work formerly performed by hand and do it with much more speed, accuracy and neatness.

The duties of a bookkeeping-machine operator are similar to those of a bookkeeper, except that the work is performed by setting up and operating a bookkeeping machine. As with the bookkeeper working by hand, the work may be subdivided, as Bookkeeper (Accounts Payable) or Bookkeeper (Accounts Receivable).

Advancement

Junior clerks are seldom promoted to the position of bookkeeping-machine operator except for training on only one phase

of the work, but billing-machine operators occasionally have the opportunity to learn the complete duties of the bookkeeping-machine operator. Promotion for bookkeeping-machine operators is somewhat restricted, as training and experience in machine operation is rather specialized. Where several operators are employed, there may be an opportunity to become supervisor.

Billing-Machine Operator

The billing-machine operator does all the necessary billing by machine. This worker may replace a typist who had previously performed this task. The operator sets up and operates a machine on which she prepares bills, invoices and statements to be sent to customers. She calculates extensions and additions, using a calculating unit which may form part of the machine. She may also type information on bills and invoices using a typewriter keyboard on the machine.

Advancement

The position of billing-machine operator may be a promotion for a typist. She may be trained on the job or sent to the machine manufacturer's training centre for one or two days for a brief instruction period in one phase of the work.

The billing-machine operator may be promoted to the position of bookkeeping-machine operator. This is often a gradual process of training on the job and helping or replacing a regular operator on occasion. It usually means extra work with no prospect of a salary increase during the training period.

Calculating-Machine Operator

Although many machines may be included in the broad term "calculating machine", this section deals specifically with those which have figure keyboards of approximately one hundred keys. A well-known example is the Comptometer.

Calculating-machine operators work on machines with figure keyboards to compute, check or verify calculations. They may work on inventory and payroll computations, invoice extensions, work sheets, financial statements, discount and interest, costing or any other statistical work.

They may have other simple related duties such as posting and filing.

Advancement

Calculating-machine operators who take an intelligent interest in the work and endeavour to understand reasons for the calculations, may soon find their interest drawn to one particular phase of the work. They may then be able to decide if further study along that line will be useful to them. They should, before going to any expense, discuss the matter with an immediate supervisor or with a member of the personnel department. At times, practice and familiarity with the work will be sufficient to merit promotion.

Where there are a number of calculating-machine operators, and a section is set aside for them, an operator may become head of the section, but such opportunities are not numerous.

Other positions they may hope to obtain in time are: payroll clerk, statistical clerk or cost accounting clerk. In order to work as a cost accounting clerk, however, further studies at university level are usually required.

Calculating-machine operators complete, check or verify calculations

TABULATING-MACHINE GROUP

Toward the end of the nineteenth century, Dr. Herman Hollerith invented the forerunner of our present-day punch-card-tabulating system. Dr. Hollerith's idea then was to speed up tabulation of the census. Today, many large business firms and government offices depend on punched-card data to supply them quickly with the latest statistics for the formulation of future policy.

The Tabulating Group is divided into two sections:

1. Key-Punch and Verifying Operators
2. Tabulating-Machine Operators

It is possible for the key-punch and verifier operators to do some tabulating work, but generally there is a distinction between the two sets of duties. Most key-punch operators are women and, on the other hand, most tabulating-machine operators are men. Generally, work proceeds from one operation to another as follows: information transferred to cards on the key-punch machine is checked for errors on the verifier. The sorting machine selects cards according to a pre-determined characteristic, or arranges them in numerical or alphabetical sequence. Tabulation then provides the desired statistics.

Stages in Data Processing

$$\begin{tikzcd}
\text{Original documents} \arrow[d] & \text{Statistics} \\
\text{Key Punch} \arrow[d] & \text{Tabulating} \arrow[u] \\
\text{Verifier} \arrow[r] & \text{Sorting} \arrow[u]
\end{tikzcd}$$

The occupations in this group will be treated separately only in the description of duties.

Personal Qualifications

As with the accounting group, hand and finger dexterity, good eye-hand co-ordination, and good eyesight are of prime importance.

Mental alertness and ability to grasp new ideas quickly are necessary. Emotional stability is essential because of periodic pressure of work.

Working Conditions

These machine operators, more than those of any other category, are likely to work in a group in a separate room. There will be

more noise but the room may be sound-proofed and their working conditions equal to, or better than, those of other office employees. Supervisors are usually more lenient with employees who work under conditions which may create nervous tension.

Salary

The average salary for key-punch operators in 1958 was $53; the range, $45 to $65. Tabulating-machine operators received $60, with a range of $45 to $75[1].

There are no available statistics for the other two types of operators but their salaries would presumably be similar to those of key-punch operators.

Training and Advancement

This group of machine operators is either trained on the job or sent for training to the company servicing the machines.

The learning period depends on the complexity of work performed on the machine and the number of machines which form part of the specific job. The period varies from three months to two years.

For alphabetic key-punch and verifier machines the employer, as a rule, chooses a typist for training. On numeric machines he may choose an employee who is adept in the operation of adding or calculating machines.

Tabulating-machine operators are usually trained separately from the key-punch group, depending upon the size of the installation. They may be expected to wire panels which control the machine operation.

Should an integrated data-processing system ("automation") be installed, the tabulating-machine operator would be a logical choice for special training on new procedures.

Key-Punch (Card-Punch) Operator

These workers operate machines with alphabetic keyboards similar to a typewriter, a numeric keyboard, or a combination of both. By depressing the keys on the machine, they punch holes in cards to transcribe information to them, in coded form.

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[1] In three major Canadian cities. Vancouver not included in figures for tabulating-machine operators.

They may operate verifier, sorting, and tabulating machines. Other duties include filing.

Verifier Operator

The work of these operators closely resembles that of the key-punch operator. Although operated in the same manner as the key-punch, this machine does not punch holes in the cards—it checks previously punched cards for errors.

Sorting-Machine Operator

These workers operate machines that automatically sort punched cards into any desired series or classification. They place punched cards in feeders, set the machines to sort the cards as required, and remove sorted cards from the bins in proper sequence.

They may also operate verifier and tabulating machines, and may do some filing.

Collating-Machine Operator

This machine requires panel board wiring and its prime purpose is to collate and sequence-check punched cards.

Key-punch operators transcribe information to cards in coded form

Calculating-Machine Operator

This machine requires panel board wiring and can perform multiplication and division for any sequence of mathematical requirements.

Tabulating-Machine Operator

This machine requires panel board wiring and from the punch-card information lists card totals, and generally transfers the punch-card information to printed information.

Sorting machines sort punched cards into any desired series or classification

OTHER OFFICE APPLIANCE OPERATORS

In many offices there are some machine operators who cannot readily be grouped into any definite category. A few of these operators are the *duplicating-machine, embossing-machine,* and *addressing-machine operators.*

Personal Qualifications

Physical qualifications are important in *duplicating-machine operators,* as the work requires stooping, lifting, standing and walking. They should be able to understand and follow simple mechanical instructions. This work is usually performed by men or boys.

The principal qualification for *embossing-machine operators* is good nervous stability, as the machine is noisy. This job is particularly suitable for a totally deaf person who can work completely unaware of the noise of metal striking metal. (The most recent machine models, with tape-reader attachments, are comparatively noiseless.)

The *addressing-machine operator* needs average intelligence to understand and follow instructions. Addressing machines are usually operated by women or girls.

Education and Training

The educational requirements for *duplicating-machine operators* are not high. Grade seven or eight schooling is usually sufficient. It is only in cases where they are expected to cut the stencils for the machine that training equal to that of typists is required. *Embossing-machine* and *addressing-machine operators* should have at least grade eight schooling. An elementary knowledge of typing is usually required but speed is not necessary.

The operation of these machines is learned on the job. A training period of approximately three days followed by close supervision for two weeks is usually sufficient.

Working Conditions

The *duplicating-machine* and *embossing-machine operators* have working conditions that often resemble those of factory workers. They work apart from the general office group, usually wear smocks or aprons, and may be paid on an hourly basis. The *addressing-machine operator* is on a higher level.

Salary

Salaries for office equipment operators with the federal government range from $1,860 to $4,020 per year. Supervisors receive from $3,570 to $6,180. Other salary statistics are not available.

Duplicating-Machine Operator (Mimeograph, Multigraph, Multilith Operator)

These workers operate machines which make duplicates of typewritten or handwritten matter. They must set up and adjust the machine, watch the operation, feed blank sheets to the machine or place them on a feed table, and remove printed copies. They may keep a record of the number and kind of copies made. On occasion, they may be required to prepare stencils or master copies using a typewriter for the stencils or printed material, and a pen and ink for any diagrams. The occupational title may vary according to the trade name of the machine operated, such as mimeograph, multigraph, or multilith operator.

The duplicating machine makes copies of typewritten or handwritten material

Advancement

Any junior employee who possesses the necessary personal qualifications may be promoted to this occupation. An elementary knowledge of typing and drawing is helpful.

There is a similarity in duplicating-machine operation and some printing trades. A young man with duplicating-machine experience may, therefore, consider the opportunities to become an apprentice in one of the printing occupations. (See CANADIAN OCCUPATIONS Monograph No. 9, *Printing Trades.*)

Embossing-Machine Operator (Graphotype Operator)

This machine stamps information, such as names and addresses, on thin metal plates for use on other office machines.

On the manual machine, the operator turns the wheel to set the proper character or letter in position, then pulls a lever to lower a die which stamps the character or letter on the metal plate.

On the electric machine, the information is typed on a keyboard similar to that of a typewriter. Because this machine is printing on metal, however, the action is much slower than that of a typewriter. (On recent tape-reader models, a punched tape activates the machine to type the plates automatically and noiselessly.)

The operator places the blank plates in a holder on the machine and removes the finished plates. The plates are inserted in individual cardboard frames and filed alphabetically.

Advancement

A junior employee of either sex may be promoted to this position. An elementary knowledge of typing may prove a slight advantage.

As a respite from the embossing machine, the worker may be given the opportunity to operate an addressing machine at periodic intervals. Eventually, when a vacancy occurs, the embossing-machine operator becomes an addressing-machine operator. The two jobs are frequently combined.

Addressing-Machine Operator (Addressograph Operator)

This worker operates a manual or an electric machine which prints names and addresses and other information on office forms. She sets up and adjusts the machine to regulate the flow of work, sets embossed plates or stencils in feeding compartments and places

envelopes and accounting forms to be addressed on the loading rack. The machine automatically feeds the plates or stencils and the article to be printed through the mechanism.

The operator may use an embossing machine to correct errors made in stamping the plates. She may also type lists of names and addresses to be submitted to the embossing section for new plates.

Advancement

There is no direct line of promotion from this job except possibly to supervisor of the addressing unit if a number of addressograph operators are employed. The addressograph operator's future in office work will depend on her own effort and initiative in obtaining further training for other office occupations.

THE COMING OF OFFICE "AUTOMATION"

Until recently, office mechanization has been carried out mainly within the old framework of office organization. It was an attempt to cope with the ever-increasing tide of "paper work" as business operations became bigger and bigger, and to try to stem the corresponding increase of clerical help, reduce salary costs, and improve the efficiency of office functions.

The advent of electronic data processing (EDP) equipment promises to be the solution for streamlining office operations to carry the growing load of clerical work. This equipment is designed to function at amazing speed, to reduce the work (and errors) in calculation and transcription, and to reduce or even eliminate some of the intermediate steps necessary under the traditional systems.

The equipment for electronic data processing consists of an electronic computer connected to a number of additional (peripheral) machines which may include tape or card punching units, card-tape converters, high-speed printers, and a central control panel called a console. Original data are inscribed on tape or cards in "machine language" (code) in the first step of the process, and automatically transcribed, coded and decoded in all further steps. If the original information is correct, and the equipment is functioning properly, the work is performed quickly, effortlessly, and without error.

Electronic data processing has been used with success in a wide variety of office functions. One can easily imagine the enormous amount of work involved in calculating and preparing the regular pay cheques for, say, 5,000 employees of a large firm. An electronic data processing unit, when properly "programmed" to perform the operation, can do the same work in a matter of minutes, with much less risk of error.

Keeping track of all reservations and cancellations for passengers on a large commercial airline or railway system is an equally formidable undertaking. A good communication system working in conjunction with a computer unit makes it possible for clerks at each booking office to know, within minutes, exactly what space is available on any route in the system.

These are but two examples of the clerical work being done by electronic data processing. There are many others: for example,

billing operations for public utilities companies; calculation of insurance dividends, commissions and actuarial statistics; preparation of statistics and research reports for government departments; inventory control; market analysis, sales forecasting and production estimates; and complete banking operations.

How Will EDP Affect Office Workers?

In order to make full use of electronic data processing as it is conceived at present, considerable re-organization of the office staff may be necessary. Traditional lines of communication, functions and responsibilities, as shown on page 15, may have to be altered or abandoned to make way for a new concept of office operation utilizing electronic data processing equipment.

A clear picture of the "automated" office has not yet emerged, but there are broad indications of what may happen to various groups of clerical functions. It is likely that repetitive hand work (calculating and preparing pay rolls, making bookkeeping entries, filing, etc.) may be eliminated to a great extent.

Occupations least affected by EDP will likely be those requiring considerable judgment or contact with other people, such as those of secretary and receptionist. In other occupations, that of typist, for example, the addition of tape-writing attachments to the typewriter transforms it into a "feeder" machine for the computer unit, but leaves the basic operation unchanged. Key-punch operators and coding clerk occupations have also been brought into the EDP system without any basic change in duties.

Distinctly new occupations have appeared as a result of EDP but are still in the process of change. A period of stabilization will be necessary before career opportunities can be identified, and more research is needed to determine what training or retraining will be necessary for the new functions.

The effect that EDP will have on existing office staffs, or on young people now training for office work, will also depend on how widespread its adoption is, and the speed with which it takes place. Thus far in Canada, it has been installed in about 25 large firms in varying degrees. The high cost of EDP equipment, and the considerable planning and re-organization often necessary for installation, tends to restrict its use to only very large firms in which clerical work is heavy. Some firms, out of sheer necessity, will be forced to adopt EDP in order to cope with their expanding operations. It is possible, however, that EDP services on a part-

time rental basis, or the use of "junior" size equipment yet to be developed, may make it profitable for small firms to consider.

We are truly on the threshold of an electronic era in office operation. Only dim suggestions of the things to come are discernible at present. The office as a control and information centre will probably play an increasingly important role in the conduct of the nation's business and services. We may expect eventually a sharp reduction in many routine and repetitive clerical jobs and a relative increase in jobs requiring good educational background and special training.

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CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices.

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Monograph 46

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Prepared
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MINISTER

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DEPUTY MINISTER

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FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from youth faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials, and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of this series.

This series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the National Employment Service of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

This monograph was written by Helen Traynor and William Coe under the direction of William Allison, Head of the Occupational Analysis Section. The generous assistance of the following is appreciated: the National Secretaries Association, The Bell Telephone Company of Canada, the Civil Service Commission of Canada, the Women's Bureau of the Department of Labour and various office machine companies.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

June 1963

COVER PHOTOGRAPH

Ontario Hydro for the Department of Citizenship and Immigration.

Black-and-white photographs used to illustrate this booklet were supplied by the National Film Board of Canada and International Business Machines Company Limited.

CONTENTS

THE OFFICE AS A FIELD OF EMPLOYMENT

The Office is a base of operations for the administration of an enterprise, for contact with outside establishments and individuals, and for record-keeping. These three functions are the source of many clerical occupations.

OFFICE OCCUPATIONS

HISTORY AND IMPORTANCE

Scribes were the first clerical workers. Some were appointed to record the king's activities, others chronicled religious events and still others wrote down the laws and judgments of the courts. In ancient days, merchants had scribes write letters, draw up contracts and deeds of sale, and keep records of goods or business transactions—a relationship similar to that of employer and office worker of the present day.

Records show that man signed his name or mark to a contract as early as 300 B.C. Agreements of all kinds, buying and selling of property, bookkeepers and commercial agents are all mentioned in Babylonian records of 2500 B.C.

Throughout the centuries however, clerical work was of minor importance in the business world. Few clerks were needed when direct contact between producer and consumer, or employer and worker, was possible.

It was not until the coming of the Industrial Revolution that systematic bookkeeping became necessary. Introduction of machines greatly increased factory production, direct contact between employer and worker diminished, and ever-increasing numbers of clerical workers were required. Improvements in office methods and equipment, however, for many years, lagged behind factory methods.

Invention of the typewriter was a promise of things to come and was to lead to other mechanical equipment such as tabulating and calculating machines and, eventually, to electronic equipment.

The first recorded attempt to invent mechanical equipment appears in the British Patent Office files of 1714 and is of a machine to write alphabetical characters. But it is only within the past 100 years that the forerunner of the present typewriter was marketed. In 1886, Christopher Scholes received an American patent for a machine he called a *type-writer* and, in 1873, E. Remington & Sons obtained a contract to market the machine on a commercial scale. Probably the first typewriter was introduced

into Canada in 1885 by the Underwood Company, pioneers in the Canadian market.

Introduction of the typewriter created a need for operators but, prior to 1900, touch typing was practised only by operators of exceptional skill. Eventually classes of instruction in touch typing began to appear. Modern commercial schools had their early beginning in efforts such as that of the Y.W.C.A. in New York which, in 1881, offered a course in type writing—eight young ladies applied and took six months training.

Two important changes can thus be attributed to the typewriter: the education curriculum was expanded to include commercial subjects; and the doors of the business world were opened to women.

With the arrival of industrialization in Canada during the past half century, office work has become the fastest growing of all occupational groups. The number of clerical workers increased from less than 60 thousand—3 per cent of all workers—in 1901, to 540 thousand—10 per cent of all workers—in 1951. By 1961, this figure exceeded 800 thousand, or almost 13 per cent of the total labour force.

Several developments have contributed to this substantial increase. Factory production multiplied tremendously, improved work methods and machinery were introduced, thus creating a need for systematic clerical work. Increased factory production meant expanded trade which, in turn, demanded a higher proportion of clerical workers. Greater production and trade has resulted in more and larger financial institutions for banking, insurance and so on. In addition, government activity and record-keeping in connection with old-age pensions, family allowances and motor vehicle licensing all entail vast amounts of clerical work.

The influx of women into office employment, which started with the advent of the typewriter, has continued ever since. Until 1941, men outnumbered women in clerical work but the 1951 Census revealed that, for the first time, the ladies were ahead; today, for every three men in clerical work there are almost five women.

Within the past decade, dramatic advances have been made in office equipment and we are now on the threshold of the electronic

age. The recently introduced electronic computer has taken over the processing of masses of data and makes it possible to obtain valuable information which, until now, was considered too costly and time consuming.

In an age of scientific management, the office has assumed an important role as a directive and controlling force in commerce and industry. With more widespread use of advanced equipment, office workers will be relieved of much repetitious work and will require a high standard of education and training for the highly skilled occupations which are arising.

This booklet describes many of the clerical occupations to be found in offices. It does not cover executive, technical or other occupational groups who work from or in an office in a non-clerical capacity, except to indicate working relationships where they exist.

EDUCATION AND TRAINING

Clerical workers need a relatively high standard of education. A general requirement is a sound knowledge of grammar, spelling and arithmetic. An office worker's chances of advancement depend on the amount of basic academic education obtained, and high school graduation is often a minimum educational requirement in companies which have planned methods of employee promotion.

In a large portion of Canada, English is the only language required, but there are many French-speaking communities, particularly in the Province of Quebec where French is required. The existence of two languages creates a need for bilingualism in an increasing number of occupations, particularly in large business centres, such as Montreal, and in government positions. Other languages may be necessary in import-export firms who do business with foreign countries.

Instruction and practice in many office skills may be obtained through high school courses and on the job. Operation of specialized office machines, such as the bookkeeping machine or the calculator, is usually taught at training centres established by makers of the machines or in business colleges. The centres are operated on a fee basis, as are business colleges, and issue certificates of competency on successful completion of a course.

The most common business courses are in bookkeeping and stenography. They may vary in scope from a course of six months which is limited to the acquisition of a minimum knowledge of the subject, to a post-high school course of three years such as secretarial courses offered in Institutes of Technology. A three-year correspondence course to enable secretaries to broaden their knowledge and qualify as "Administrative Assistants" is provided by the Association of Administrative Assistants, in conjunction with the University of Toronto.

Recognition as a Certified Professional Secretary is given through a six-part, twelve-hour examination sponsored by the National Secretaries Association (International) and administered through one of its departments, the Institute for Certifying Secretaries. This examination takes into account knowledge and judgment gained through actual job performance as a secretary and requires a work experience varying from three to eight years, depending on formal educational background. The examination is held once a year in May at approved testing centres.

Bookkeeping studies may be continued at university and lead to a bachelor of commerce degree with specialization in accountancy. Some universities such as Western and Acadia, and Waterloo College, offer specialization in secretarial practice in courses which may be credited toward a bachelor of arts degree.

Evening and correspondence courses[1] are other ways of acquiring office skills. Employees who feel the need for further education may enroll for a business course, evening high school, or even university studies. However, hard work, ambition and perseverance are essential to success in studies which are pursued after a person's normal work day.

1. Department of Labour, Ottawa, *Canadian Vocational Correspondence Courses*, free on request.

PERSONAL QUALITIES NEEDED

Many different types of people find office work suitable to their temperament because of the great diversity in office functions. Some office duties require special personal qualities; for example, the duties of receptionists and order clerks demand qualities that enable them to deal effectively with the public, but the duties of, say, the duplicating machine operator, place much less emphasis on such qualities.

Office workers are expected to be well-groomed, courteous and tactful; willing to co-operate and do a share of extra work that often occurs. The ability to concentrate amid noise and distraction, and a good memory for details, are valuable assets. Rush periods, heavy responsibility and other emergencies, call for emotional stability. Some office work, especially in small offices where only a few persons do all the clerical work, requires considerable initiative and versatility.

Office work—much of it sedentary, and generally classified as having light physical demands—is an important source of employment for many physically handicapped people, if they have the necessary educational background or training. The usual care in matching a person's remaining abilities with the physical requirements of the position must, of course, be observed. Demands for eye-hand co-ordination, finger dexterity, and the ability to move about, vary widely in office jobs.

There are standardized tests designed to measure what is called clerical interest and aptitude. In the hands of qualified counsellors, such tests help to determine one's suitability for office work.

No particular minimum age limits are required for entry into office work, other than that imposed by provincial law or the demand of the work for maturity and experience.

In small offices employees need initiative and versatility.

SEEKING EMPLOYMENT

Many employment opportunities occur each year in clerical occupations because of the high number of women who leave for marriage, to take care of children and for other reasons. This and the fact that office help is required in almost every community, makes it relatively easy for those with adequate education and training to obtain employment without going too far afield.

In planning a systematic job-seeking program, prospective office workers may use a variety of sources of information. The National Employment Service, with offices in all principal Canadian centres, brings together the employer seeking help and the applicant looking for work, and offers a counselling service to young people who are seeking their first jobs.

Job seekers may also find useful leads in the employment columns of daily newspapers, or they may apply directly to likely employers without reference to any particular vacancy.

Students who are on the point of graduation from a business course or high school may find, on inquiry, that the school has a list of employers interested in obtaining clerical workers.

Applicants for clerical positions are usually requested to fill out application forms, particularly in large business firms. The neatness with which this is done may be taken by the employer as an indication of the quality of work to be expected from the applicant —an important point to be remembered by the prospective office worker.

It is also quite common for employers to screen job applicants, using one or more tests of clerical aptitude and proficiency. Applicants for clerical work should, therefore, be prepared to be tested during the hiring process.

Governments at all levels are extensive users of clerical help. Hiring for positions in the federal government is done by the Civil Service Commission through competitive examinations that are held in principal centres throughout Canada. Information on job opportunities may be obtained from posters displayed on public notice boards in Post Offices, and offices of the National Employment Service and the Civil Service Commission. Applicants, as a rule, are expected to have at least five years residence in Canada and must possess the minimum qualifications for the position advertised.

WORKING CONDITIONS

Office work is such that good physical working conditions are easily attainable. Proper ventilation and good lighting are taken for granted but, in a rapidly expanding business, office staff may, at times, be crowded.

Salaries paid in specific office occupations are to be found in the tables provided at the end of this booklet. Education and training have a direct bearing on the salary a beginner may expect. Clerical workers are generally paid weekly or semi-monthly.

The 37½-hour week is the most common, and office hours are from 8:30 or 9:00 a.m. to 5:00 or 5:30 p.m. with one hour for

lunch, five days per week. A period of ten to fifteen minutes for a coffee break morning and afternoon has become an established custom.

Time off during the week is the usual arrangement when Saturday work is necessary—employees, as a rule, take turns on duty if the office must remain open every Saturday. Accounting staff may be obliged to work overtime as the end of an accounting period approaches; some employees may be obliged to reach a daily balance before leaving for the night.

As a rule, a vacation of two weeks with pay is granted after one year of service, and three weeks after 15 years. Some firms grant four weeks after 25 years service. There are also approximately eight statutory holidays.

Pension plans in which the employer pays at least 50 per cent of the premium, and group life and hospitalization insurance, exist in most large companies.

A first-aid room with a nurse or first-aid attendant on duty is often provided and in some large companies, employees may even receive treatment prescribed by their own doctor, such as injections or heat-lamp treatments. Sick leave without a medical certificate or loss of pay is the rule provided that such absences do not occur too frequently.

Many companies have cafeterias where meals are available to employees at cost.

ORGANIZATIONS

According to an article in the January 1953 issue of *The Labour Gazette,* it is only in the last fifteen years that any significant number of office workers have become organized. "The slowness of office workers [in the manufacturing industry] to organize, in comparison with plant workers, can be attributed to a number of factors, most of which are not peculiar to manufacturing but apply to industry generally.

"Fifty years ago, office workers generally commanded substantially better working conditions than production employees. Clerical staffs were small and, as a rule, closely associated with management, a situation which not only contributed to better working

conditions for the white-collar group but made them feel more closely identified with management than with labour.

"Developments of the past half century, however, have changed the conditions of office work. As industrial units have expanded, office staffs have grown larger and many clerical jobs have become routine and mechanical in nature. At the same time, non-office workers have made rapid gains in employment conditions, and many of the advantages formerly associated with office employees now apply equally to plant workers. During the past 10 or 15 years clerical employees have undoubtedly become more receptive than previously to unionization.

"One obstacle to the unionization of white-collar workers is the high proportion of women doing office work. Since many women regard their employment as temporary, they often show little response to the long-range goals of unions."

For reasons given above, the majority of office workers are not organized. Those who are may belong either to unions composed solely of office workers, or to unions drawing members from both office and non-office workers in a plant or industry. The Office Employees International Union, drawing membership largely from the pulp and paper industry, and the American Newspaper Guild, are examples of office worker unions. Production worker unions covering office and non-office workers in some plants include the International Association of Machinists, United Automobile Workers, United Steelworkers of America, International Union of Electrical, Radio and Machine Workers, and others. There are, in addition, a number of employee associations, and mixed plant and office worker bargaining units.

Many office workers are employed by municipal, provincial and federal governments, in which case they may be represented by civic employee unions or civil service organizations.

Among office workers, secretaries appear to be most active in attempts to organize as an occupational group. The National Secretaries Association and the Association of Administrative Assistants are each working toward recognition of professionally qualified secretaries.

Structurally, office organization is like a pyramid. At the top is a manager, director, or president, in general control. Reporting directly to the manager are department heads each responsible for general direction and control of a group of the office staff. Department heads, in turn, have a number of section supervisors each directly responsible for the work of a segment of the office workers within the department. The base of the pyramid may include hundreds of rank-and-file clerical workers.

Office organization depends largely on the type of business, number of employees and amount of mechanization and integration of clerical functions. Very small offices with one or two employees obviously do not require an organizational chart to determine work division.

Offices of doctors, lawyers, business agents and many others operating on an individual basis are typical small offices. One person often acts as receptionist, secretary-stenographer and bookkeeping clerk. Office machines are usually limited to a typewriter and an adding machine.

In establishments where there is considerable clerical work, as in head offices of insurance companies and banks, and in offices of large manufacturing concerns, the office staff is numerous and division of work and departmentalization occur. For example, one may find a personnel department responsible for employment and welfare of employees, an accounting department to handle financial matters, and purchasing and sales departments for the buying and selling. Departmentalization tends to increase with each increase in the size of the organization.

Chart 3 is a simplified picture of a large company showing a division into five main departments. Charts 3a and 3b give a departmental breakdown. Each section may be regarded as an almost self-contained office within the larger structure. For example, the credits and collections section under the direction of an official may include stenographers, typists, various bookkeeping clerks and machine operators. The medical unit, on the other hand, is often relatively small. It may resemble a doctor's office in private practice, and have only one clerical employee, a receptionist-stenographer, working for the doctor.

CHART 3—BASIC FUNCTIONAL ORGANIZATION STRUCTURE

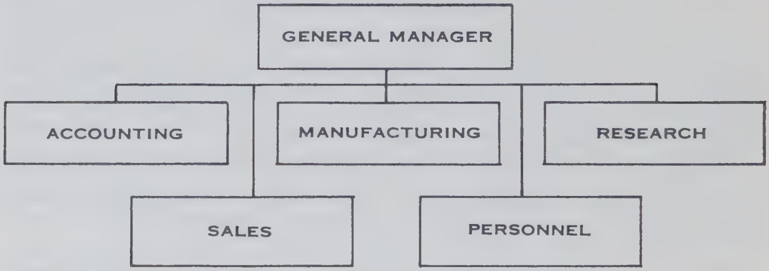


CHART 3 a. DEPARTMENTAL FUNCTIONAL ORGANIZATION—ACCOUNTING DEPARTMENT

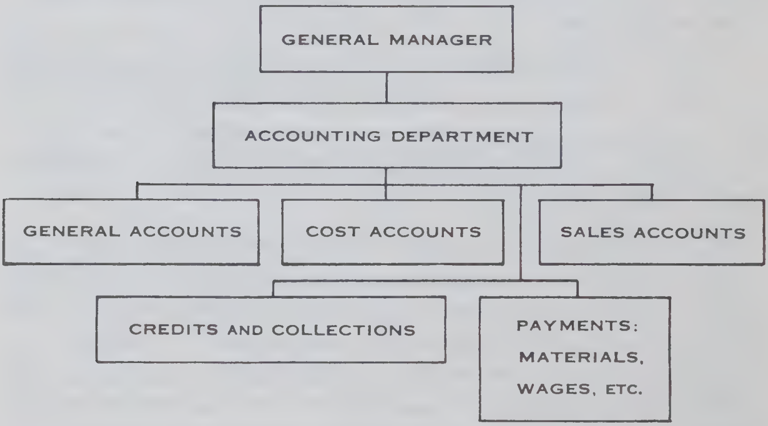
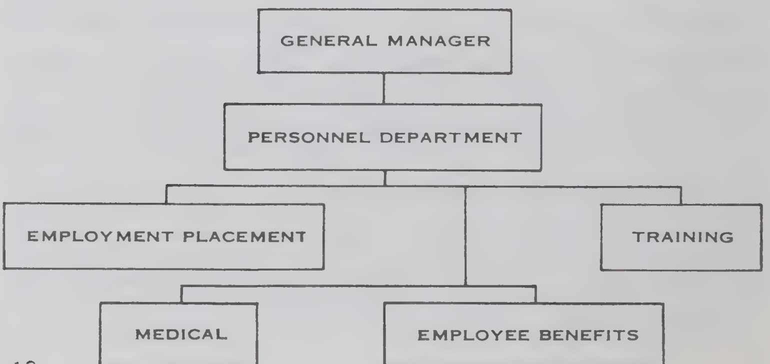


CHART 3 b. DEPARTMENTAL FUNCTIONAL ORGANIZATION—PERSONNEL DEPARTMENT



NATURE OF WORK

Office work consists of a wide variety of clerical duties. These duties may be grouped according to similarity of the work, training and personality required. Thus, the *secretarial* group is primarily concerned with typing and correspondence. The *public contact* group, as the name implies, have duties in which they deal more or less directly with the public. *Records and processing clerks* handle and process correspondence and records other than financial data. The *accounting* group is occupied mainly with recording and analysing financial data. The mechanization of many office procedures has created other groups of increasing importance concerned with the operation of a wide variety of mechanical office equipment. Each group is dealt with separately.

THE SECRETARIAL GROUP

Much office work is concerned with correspondence and other written communication. This is usually typewritten and the text is often dictated to a stenographer or, by means of a dictating-machine, to a typist. When the subject matter is of a confidential or personal nature it is usually entrusted to a secretary.

Secretarial work—a continuous process of learning and development.

The secretarial group includes: *secretary, stenographer, dictating-machine operator,* and *typist.* These workers should have a good command of language with special emphasis on grammar and spelling.

Secretary

The word "secretary" is derived from the Latin *secretum* meaning "one entrusted with a secret", indicating that the chief function of a private secretary is to be a *confidential* assistant.

The secretary reads all incoming correspondence addressed to her employer and determines which letters must be brought to his attention; the others she answers herself or refers to someone else for reply. Acting on her own initiative and on general instructions, she writes letters to suit her employer and may often dictate to a stenographer. She deals tactfully with office visitors and, if necessary, arranges appointments for them to see her employer.

A good secretary should be able to prepare material for reports and speeches, take shorthand notes and type rapidly. Very often she has to look after files in which are kept all the material to which her employer most frequently refers. She also files personal and confidential correspondence. When her employer must travel, she usually makes arrangements for his transportation and hotel reservations. In brief, the ideal secretary does everything possible to save her employer's time and energy for executive matters.

She is a person who stands between an executive and many minor irritations and routine interruptions. In order to assume responsibility for independent decisions she requires initiative and good judgment as well as proper training and background. In directing to lesser officials people who may have originally expected her employer's attention, the secretary needs tact and an understanding of human nature.

Above all, a secretary should have discretion, loyalty and a sense of responsibility, as she will be the recipient of much confidential information. She must not only keep this information to herself but refrain from hinting to friends about the secrets she knows. In addition, she should have the attributes of a first-class stenographer.

High schools, business colleges and some universities offer courses in secretarial practice. The duration of the course varies from one to four years depending on the type of education being offered. For example, a high school or business college may give a course of one year of intensive training in business correspondence, office practice, shorthand and typing. Several Institutes of Technology have courses, usually of three years and open to high-school graduates, in secretarial science and related subjects. At university one may specialize in secretarial practice while working toward a bachelor of arts degree.

The private secretary may work in the same office as her employer, or may have a separate office of her own or shared with another. She is seldom expected to work in the large outer office.

A new employee seldom enters a company as a private secretary — at least two years experience with the company as a stenographer is usually a prerequisite. An executive often selects one of the more competent stenographers to be his secretary.

Private secretary is considered a terminal job in the line of promotion from typist, dictating-machine operator or stenographer to secretary, and some will be satisfied to have reached this goal. There are various distinctions among secretaries, however, and the secretary to a vice-president or president of a company is on a much higher plane than the secretary to a junior executive. A continuous process of learning and development is essential in order to reach the higher levels, but it is a distinctly rewarding experience to work with a person who is at the pinnacle of success.

On rare occasions, a secretary may advance by obtaining the position of her superior when he moves to another job or retires; another may transfer to a position, within the company, which allows more scope for executive ability. The ambitious secretary can prepare for promotion by taking courses in such subjects as business organization, economics and commercial law.

Stenographer

The word "stenography" is derived from the Greek words *stenos* and *graphia,* which mean a short method of writing. Stenography dates from the year 1837 when the Pitman system of shorthand was introduced; the Gregg system followed in 1888.

A stenographer writes the dictation of correspondence, reports, and other matter in shorthand, then transcribes and types the dictated material. A knowledge of technical language or terms used in particular professions may sometimes be required.

. . . quick and accurate in shorthand and typing.

Other duties are to see that enclosures are attached to letters and, when necessary, tactfully remind her employer of information which he may have promised to supply to his correspondent.

Very often a stenographer must also maintain files and records, type forms, prepare stencils and use a duplicating machine. She may take and transcribe minutes of meetings, and handle routine correspondence. On occasion, she may replace an absent secretary.

To be successful, a stenographer must be quick and accurate in shorthand, typing and spelling. As she often works in a large office, she should be able to concentrate in the midst of distractions. She needs a good memory for details and tact in dealing with others. The stenographer may often have private information about the firm for which she works and must, therefore, be discreet in discussing her work with others.

Complete high school education is desirable, but Grade 10 or Grade 11 is often accepted as suitable educational background.

Proficiency in typing and shorthand is expected of a stenographer. Shorthand speeds of 100 to 120 words per minute and typing speeds of 50 to 60 words per minute are the usual standards set by commercial schools and business colleges for their graduates. However, speeds of 60 and 30 respectively are often accepted by employers hard-pressed for stenographic help.

Stenographers usually work in the general office area, frequently moving to private offices to take dictation. The noise and distraction of other office workers and office machines is usually present. In large offices, beginner-stenographers may start in a stenographic pool where they, among many others, will be available on call for a variety of stenographic duties throughout the firm. Appointment to a specific department may be made at a later date when they have acquired sufficient experience.

Most stenographic positions are filled from outside the company, but an office clerk who qualifies by completing the necessary stenographic course is almost immediately promoted to a stenographic position. The line of advancement for stenographers in large companies is through established grades by which they may progress from junior stenographer to intermediate, to senior stenographer and, at times, to secretary.

The stenographer who is competent in her work and has given some indication of leadership qualities may become head of a stenographic pool. Her duties then would be to see that the work is properly divided among the stenographers, read finished material, make any necessary corrections, be responsible for the general order and efficiency of the section, and coach junior employees. She would also be expected to keep a record and make reports on the work done by each stenographer in her section.

The ability to perform the duties of *legal stenographer, medical stenographer* and other stenographic positions where technical terms are used is usually the result of some experience and familiarity with the terminology.

A stenographer with a good background of experience and knowledge, if living in a large city, may go into business for her-

self as a public stenographer, establishing her office either in or near a large hotel to get the travelling trade. Public stenographers usually charge by the page or folio, and work for clients who need temporary stenographic services.

Expert stenographers may become verbatim reporters whose duties are to transcribe exact reports of proceedings at important conferences, association meetings, in court and in parliament. Travelling, with all expenses paid, is sometimes part of the job.

Typist, Dictating-machine Operator

Invention of the typewriter has had far-reaching effects not only on office occupations but also on the composition of the office staff. It opened the doors of the business world to women and today 96 per cent of all stenographers and typists are female.

The dictating-machine operator is included in this section because typing is required for the transcription of dictated material. *Vari-typists, teletypists* and *automatic-typewriter operators* are mentioned for similar reasons.

The dictating machine, or dictaphone, is a phonographic machine which records material, dictated by means of a microphone, for transcription by a typist. The vari-typer resembles a long-carriage typewriter and has easily changeable type of various styles and sizes. The teletype machine is part of a communication system, and has a keyboard which is electrically connected to another machine of the same type at a distant receiving or sending point. The automatic typewriter has a standard keyboard and a small panel of push buttons. The buttons are for the selection of paragraphs in constructing and automatically typing the bodies of routine letters, or for setting up complete pages of material to be copied.

The *typist* makes typewritten and carbon copies of manuscripts, letters and records from original material, rought drafts or corrected copy. She should be able to note and question any grammatical errors or ambiguous expressions in the work she is given to copy. The typist also addresses envelopes, fills in report forms and index cards, and prepares stencils from which copies are made on a duplicating machine. She may often be required to type statistical material, which involves a knowledge of tabular spacing.

The *dictating-machine operator* transcribes messages reproduced in sound from wax records, discs, magnetic tapes or wires on a dictating or transcribing machine. She regulates the speed and tone of voice by manipulating the controls, and types verbal material as heard in the earphones. She may type other information which is not recorded, such as name, date and address or other identifying information, and maintain a file of records.

The *vari-typist* types letters and prepares master copies, such as stencils and tracings, on a vari-typer—a machine which produces copy with a printed appearance. The operator selects suitable size and style of type and adjusts the machine to obtain the proper spacing and even right-hand margins. Aside from the basic job of typing copy, the vari-typist may perform related art work, such as adding headings and creating decorative page effects.

The vari-typist's finished work resembles printed material.

The *teletypist* sends and receives messages to and from various distant points. By striking the letters of the keyboard at the sending point, the operator activates a similar machine which types the message at the receiving point. It may be necessary to keep a record of the messages.

The *automatic-typewriter operator* frequently operates two types of machines, each with a typewriter key-board. One machine is for typing matter which is reproduced in the form of perforations on a roll of paper similar to a player-piano roll. The other machine, in use more often, is for making copies by means of a mechanism that resembles that of a player piano. This machine is almost fully automatic, but the typist must type in names and addresses or other information which change with each copy. She often operates several of these machines at a time.

For the simplest typing duties, one or two years of high school with a good knowledge of grammar and spelling is essential. Employers expect beginners to have a minimum typing speed of

Office skills may be improved in evening classes.

forty words per minute but may accept thirty. Dictaphone, vari-type, teletype and automatic-typewriter operation is usually taught on the job, but typing skill is necessary.

A typist may work in a small office, with two or three other employees, as a clerk-typist performing many clerical jobs as well as typing miscellaneous matter. She may work in a department of a larger office where she is the only typist, or in a still larger office where she will be one of many typists doing similar work.

Positions as typist or clerk-typist are often immediately available to junior company employees who take a typing course and acquire sufficient speed and proficiency. Typists in large companies may advance from junior, to intermediate, to senior typist, and at times to dictaphone operator.

The opportunity to learn the operation of the automatic type-writer, the vari-typer, teletype and many key-punch and accounting machines which have typewriter keyboards is a form of advancement. A typist may often obtain on-the-job training on one of these machines, or she may be sent by her employer to the machine supplier for special training. This extra skill and responsibility usually leads to a salary increase. Shorthand (for those who wish to become stenographers) and the operation of some office machines are not taught on the job, but require special training.

THE PUBLIC CONTACT GROUP

Business firms realize the importance of building and maintaining customer good-will and select some employees with this thought uppermost. These workers form the public contact group which includes *receptionist, order clerk* and *telephone operator.* They speak to customers face-to-face or by telephone and may, by their general conduct, create and maintain good public relations that are highly valued in the modern business world.

Receptionist

The occupation of receptionist was introduced to office occupations with the growth of large offices. Subdivision of work, with everyone busily engaged in performing his or her own task, demanded that someone be appointed to receive and direct callers.

The receptionist is the first office employee seen by visitors and should create an immediate impression of courtesy, efficiency and mental alertness. She receives all persons who come to the office, tactfully ascertains the purpose of the visit, and directs them to

the appropriate person. Thus higher officials of the company are spared time-consuming routine interviews without loss of customer good-will.

Many companies expect the receptionist to keep a record of the name of each caller, the time of the call, the nature of the business and the person seen. Statistics compiled from this information are sometimes required.

As receptionists are seldom continually busy receiving and directing callers, they usually have other duties which can be put aside at a moment's notice. Some of these are: typing index cards, addressing envelopes, and filing.

Receptionists should have at least one or two years of high school. Neat, legible handwriting, and an elementary knowledge of typewriting and bookkeeping are an advantage.

A receptionist, dealing with the public and subject to frequent interruptions in secondary tasks, can expect very little privacy in her work. She must, moreover, be constantly in the immediate vicinity of her desk or find someone to replace her temporarily.

Salaries vary considerably according to the range of duties performed. This is, on the whole, not a highly paid occupation, because there is little specific training involved.

The position of receptionist is usually acquired through promotion from one of the junior grades in a company, or transfer from another at the same level. Because it calls for a knowledge of company policy and organization, it often requires a few months experience with the company in another capacity. Additional office skills are difficult to learn in this job, and promotion often depends on knowledge acquired through extra courses of study.

At times, a company employee with the necessary qualifications is transferred to this position for health reasons. Sometimes office employees nearing retirement age are transferred to receptionist duties to relieve them of responsibility which may have become too heavy a burden.

Order Clerk

A 1961 survey of four major cities reports 3,863 male order clerks against 1,526 female order clerks, roughly a ratio of five

to two. In all preceding occupations, female workers have predominated.

Order clerks receive orders for merchandise by mail, telephone, or directly from customers. The clerk completes an itemized order form, adding the stock code number for each item and, depending on company policy, may include prices and extensions.

They may check with the credit department to determine the risk involved in extending credit to customers, and are responsible for cash and cheques received with orders. They record money received and pass it to the cashier at the end of each day.

Files of all orders received must be maintained, and a follow-up made on any order for which a shipping invoice has not been received. (Receipt of the shipping invoice indicates that the merchandise has been shipped to the customer.) Order clerks also check shipping invoices with the original orders for errors.

The above sequence of duties may be performed by one person or divided among several. The amount of responsibility placed on an order clerk determines the avenues of advancement and the salary.

In general, education requirements for order clerks are similar to those for receptionists. Some order clerks must also have high school completion in science, or technical training, to understand the terminology used in advanced and higher-paid jobs.

Order clerks often experience rush periods when there are many people placing orders, inquiring about delivery or making complaints. Despite all this, they must keep up with the paper work involved in processing orders. They must also deal graciously with all types of customers, including the impatient, the undecided, and the very rude.

The position of order clerk may be a promotion from one of the junior grades, or it may be a phase of a regular training scheme for promising young employees. This is one part of a business that future executives are usually expected to learn.

A mail-order clerk may become a posting clerk in the accounting department with a chance to learn bookkeeping.

Order clerks whose duties are on a higher level and who have sufficient education may eventually go far in the company. They

are receiving valuable training and experience in public contact work which can lead to opportunities in the sales, purchasing, industrial relations, or personnel departments.

Telephone Operator

In business today, much attention is paid to the "voice" on the line and what it can accomplish in terms of good public relations. The office switchboard-telephone operator is, therefore, chosen with care.

The telephone operator relays incoming, outgoing and inter-office calls through a telephone switchboard, and may supply information to callers or take messages.

She records the details of all incoming and outgoing long-distance calls chargeable to the company. She may check telephone bills to verify the long-distance charges, and send the bills with record form attached to the accounting department.

She is frequently expected to do some typing during slack periods on the board. If the board is not a busy one, it may be placed in the front office, where the operator may also double as receptionist.

A minimum of two years high school is required, although junior matriculation or business school training is preferred.

The prospective operator may be sent by her employer to a telephone company P.B.X. (private branch exchange) training school for one full day of instruction, to be followed by further on-the-job training. The length and extent of the training will be determined by the type and size of the switchboard, the learning capacity of the individual and the additional duties required of her.

The telephone operator must be at her post punctually and must not leave it until the last minute of work. She has regular rest periods, which may be more frequent than those of the other office employees if the board is a very busy one.

Peak loads occur at certain periods of the day when all her time and attention must be devoted to the board. During quiet periods she may be expected to perform other duties such as typing or filing.

The telephone operator often works in the front office but where more than two regular operators are needed, the switchboard is usually in a separate room.

The position of telephone operator may be a promotion for a junior employee who has been acting as replacement on the board; others enter through regular employment channels. This work does not ordinarily lead to promotion unless additional skills are acquired. With extra academic studies, personnel and public relations are two areas where the operator's experience in dealing with the public would be an asset.

RECORDS AND PROCESSING CLERKS

These occupational titles are grouped together because, to some extent, all are concerned with handling and processing correspondence and records, excluding financial data. They represent a wide range of responsibility and knowledge demanded of the workers. Correspondence clerks and personnel clerks usually require a good background of education and experience, but the positions of file clerk, mail clerk and office boy or girl, are generally recognized as entry jobs.

Correspondence clerks are needed in establishments where there is a considerable volume of mail which does not, as a rule, require action on the executive or managerial level. It may consist of requests for additional merchandise, for information on customer credit or on insurance and pension plans. It may be claims for incorrect billing of purchases, unsatisfactory service rendered, or lost or stolen merchandise.

These workers initiate action to comply with requests or make inquiries to obtain information, and write, draft or dictate replies. A considerable amount of judgment and a sound knowledge of grammar, spelling and composition are essential.

Employers usually seek persons with at least senior matriculation. Many insist on previous general office experience.

Personnel clerks are employed in large establishments to maintain employment records of the firm's staff. They prepare documents for new employees showing name, address, qualifications, rates of pay and other details, and keep them up to date. Days absent on vacation or because of sickness must be recorded.

Supervisor's reports on ability are filed in each individual's folder and, in case of termination of employment, the date and cause. Personnel clerks may check references of new workers, or provide them for workers who leave.

At periodic intervals, personnel clerks may compile and type statistical and narrative reports from employment records.

This type of work requires mature individuals. Much personal information is entrusted to them that must be kept strictly confidential.

A typist or senior clerk may gravitate to this position. When an outsider is hired, it is usually on the basis of experience in the personnel field. It is an interesting opportunity for the employee who has a sincere interest in the welfare of others and may open the door to more advanced positions in public relations work or administrative positions in the personnel department.

File Clerks receive carbon copies, reports and documents of all kinds to be kept for future reference. This material must be classified alphabetically or numerically, by subject matter or by code number, so that it may be found without difficulty. A record is also kept of material removed from the files.

File clerks may be expected to review file contents periodically, check classification, and discard any obsolete material. They may also be expected to search for additional data to be included in reference files. The average file clerk is not expected to set up or re-organize a filing system.

The person who likes to have "a place for everything and everything in its place" and who has a sense of responsibility, average intelligence and judgment has the personal qualifications needed in this occupation. One or two years of high school with emphasis on spelling is the usual minimum educational requirement. Some large companies, however, with recognized lines of promotion within the company, prefer junior matriculation so that their file clerks may progress to higher clerical positions.

General academic schooling without specialization is sufficient, but a knowledge of typing is helpful as index cards for the material on file are often typed. No experience is required, as a rule, because this is an entry occupation.

Mail Clerks receive all incoming company mail, open and stamp the time of arrival on it, and sort it for distribution. They seal and stamp outgoing mail, weigh packages to decide correct amount of postage, and list registered mail.

Mail clerks may also distribute and collect mail, and operate different mail-room machines, such as a letter opener, a stamping machine and an envelope-sealing machine.

Honesty and a sense of responsibility are important personal attributes as money, bonds and confidential information may be sent through the mail. One or two years of high school is usually

considered sufficient for the position and no special training is required.

Office Boys and Girls are known by many other titles. Banks have page girls, some offices have bench girls or boys, and some have messengers, but their duties are alike. These young people perform all the minor jobs in an office. They run messages inside and outside the office, deliver and collect mail within the office, help in the mail room and perform other simple duties as directed.

Office boys and girls are expected to be courteous and willing, have correct posture, and be neat, clean and wholesome in appearance. Although eighth-grade schooling may be sufficient, the educational requirements will vary, depending on whether the position of office boy or girl is considered an entry occupation by the employer. Opportunities for this occupation appear to be diminishing.

OFFICE APPLIANCE OPERATORS

In many offices there are some machine operators who cannot readily be grouped into any definite category. A few of these operators are the *duplicating-machine, embossing-machine,* and *addressing-machine operators.*

Physical qualifications are important in *duplicating-machine operators,* as the work requires stooping, lifting, standing and walking. They should be able to understand and follow simple mechanical instructions.

The principal qualification for *embossing-machine operators* is good nervous stability, as the machine is noisy. This job is particularly suitable for a totally deaf person who can work completely unaware of the noise of metal striking metal. (The most recent machine models, with tape-reader attachments, are comparatively noiseless.)

The *addressing-machine operator* needs average intelligence to understand and follow instructions. Addressing machines are usually operated by women or girls.

The educational requirements for *duplicating-machine operators* are not high. Grade eight schooling is usually sufficient. It is only in cases where they are expected to cut the stencils for the machine that training equal to that of typists is required. *Embossing-*

machine and *addressing-machine operators* should have at least grade eight schooling. An elementary knowledge of typing is usually required but speed is not necessary.

The operation of these machines is learned on the job. A training period of approximately three days followed by close supervision for two weeks is usually sufficient.

The *duplicating-machine* and *embossing-machine operators* have working conditions that often resemble those of factory workers. They work apart from the general office group, usually wear smocks or aprons, and may be paid on an hourly basis. The *addressing-machine operator* is on a higher level.

Duplicating-Machine Operator
(Mimeograph, Multigraph, Multilith Operator)

These workers operate machines which make duplicates of typewritten or handwritten matter. They must set up and adjust

The duplicating machine makes copies of typewritten or handwritten material.

the machine, watch the operation, feed blank sheets to the machine or place them on a feed table, and remove printed copies. They may keep a record of the number and kind of copies made. On occasion, they may be required to prepare stencils or master copies using a typewriter for the stencils or printed material, and a pen and ink for any diagrams. The occupational title may vary according to the trade name of the machine operated, such as mimeograph, multigraph, or multilith operator.

Any junior employee who possesses the necessary personal qualifications may be promoted to this occupation. An elementary knowledge of typing and drawing is helpful.

There is a similarity in duplicating-machine operation and some printing trades. A young man with duplicating-machine experience may, therefore, consider the opportunities to become an apprentice in one of the printing occupations. (See CANADIAN OCCUPATIONS monograph, *Printing Trades.*)

Embossing-Machine Operator (Graphotype Operator)

This machine stamps information, such as names and addresses, on thin metal plates for use on other office machines.

On the manual machine, the operator turns the wheel to set the proper character or letter in position, then pulls a lever to lower a die which stamps the character or letter on the metal plate.

On the electric machine, the information is typed on a keyboard similar to that of a typewriter. Because this machine is printing on metal, however, the action is much slower than that of a typewriter. (On recent tape-reader models, a punched tape activates the machine to type the plates automatically and noiselessly.)

The operator places the blank plates in a holder on the machine and removes the finished plates. The plates are inserted in individual cardboard frames and filed alphabetically.

A junior employee of either sex may be promoted to this position. An elementary knowledge of typing may prove a slight advantage.

As a respite from the embossing machine, the worker may be given the opportunity to operate an addressing machine at periodic intervals. Eventually, when a vacancy occurs, the embossing-

machine operator becomes an addressing-machine operator. The two jobs are frequently combined.

Addressing-Machine Operator (Addressograph Operator)

This worker operates a manual or an electric machine which prints names and addresses and other information on office forms. She sets up and adjusts the machine to regulate the flow of work, sets embossed plates or stencils in feeding compartments and places envelopes and accounting forms to be addressed on the loading rack. The machine automatically feeds the plates or stencils and the article to be printed through the mechanism.

The operator may use an embossing machine to correct errors made in stamping the plates. She may also type lists of names and addresses to be submitted to the embossing section for new plates.

There is no direct line of promotion from this job except possibly to supervisor of the addressing unit if a number of addressograph operators are employed. The addressograph operator's future in office work will depend on her own effort and initiative in obtaining further training for other office occupations.

THE ACCOUNTING GROUP

The accounting department handles all the financial and statistical work of an establishment. Of the occupations in this department *bookkeeper, statistical clerk, payroll clerk* and *posting clerk* are selected because they are representative of the many occupations in this group.

Bookkeepers and payroll clerks work in all types and sizes of offices and their physical working conditions vary accordingly. Statistical clerks and posting clerks usually work in large offices and should be able to concentrate in the midst of distractions, such as noise from office machines and telephone conversations.

Bookkeeper

The bookkeeper heads the office accounting staff and is generally responsible for the work of the section. This position may

be accorded the status of accountant when a combination of experience, volume of work and degree of responsibility warrants it.

Bookkeepers record all business transactions in a systematic manner. They examine data and enter it in the appropriate record books or on special forms. They balance the books at fixed intervals and prepare reports to show income, expenses, accounts receivable, accounts payable and any other financial transactions for the period. They may prepare the Statement of Profit and Loss, and the Balance Sheet.

In a large establishment, the bookkeeping may be divided among several bookkeepers, each responsible for only one section of the work, and under the direct control of one head bookkeeper or an accountant.

The bookkeeper in a small business may, in addition, calculate and distribute wages, type invoices and send out monthly statements to customers, and also have some stenographic duties.

High school completion is considered the minimum educational standard, followed by at least one, preferably two, years additional study in bookkeeping, or accounting, in business school or at university.

The position of bookkeeper is generally a promotion from one of the lower positions in the accounting department. It usually requires at least one year of bookkeeping experience in a junior capacity.

A bookkeeper may acquire the status of accountant within a company after years of experience, but official professional recognition is accorded through the various accountants' associations only after certain conditions have been met. Associations such as the Chartered Accountants, Certified General Accountants, and the Registered Industrial Accountants require prospective members to pass written examinations and prove that they have a specified number of years practical experience or apprenticeship.

Statistical Clerk

It is important for firms to have figures prepared and presented in report form on all phases of the business. Statistical clerks perform much of this work. They prepare and analyse special and

regular reports on sales, production, the budget, special contract work, bad debts and other information of interest to management. The ability to grasp the elements of factory processes is necessary in compiling some statistics.

Figures contained in bookkeeping records are the basis for most statistical work. A calculating machine is usually necessary to figure percentages, index numbers and graphs, which are the most frequent methods of indicating trends.

High school completion, with emphasis on mathematics, is expected of statistical clerks. Some companies may prefer training in higher mathematics at university level if the work is complex.

Calculating machines are invariably used in this work but knowledge of machine operation is considered of secondary importance compared with a knowledge of percentage and decimal systems. Machine operation may be learned on the job.

As a rule, statistical clerks are chosen from the company staff. Beginners are seldom considered unless they have some university training in statistical analysis.

The position of statistical clerk may be a promotion for a factory-office[1] clerk, or an employee in the accounting department who has shown exceptional ability with figures. It may be an opportunity for a promotion from, or to, that of payroll clerk, depending on the relative degree of importance attached to each position.

Payroll Clerk

Payroll clerks calculate each worker's earnings, using information from attendance sheets, time cards, and production tickets. They post the calculated data on payroll forms, showing items such as the worker's name, gross earnings, deductions, and net wages.

Payroll clerks may use calculating machines, write pay cheques, and help in the distribution of pay envelopes. Honesty and accur-

1. A factory or production office is a partitioned space on the factory floor where foremen and other supervisors perform the clerical work connected with their positions. They may allocate much of this work to a clerk who is chosen, if possible, from among the production workers.

acy are of prime importance in this occupation, although internal audit and cross-check systems will generally uncover wrong entries.

Third year high school with a one-year business course is the usual minimum educational requirement. A knowledge of typing and calculating-machine operation is often preferred, but may be learned on the job.

At least six months experience in the accounting department at a junior position may be necessary before an employee is capable of accepting the responsibility of payroll work. Courses on calculating-machine operation, which include intensive practice on payroll work, are a good preparation for this position.

The position of payroll clerk may be a promotion from that of posting clerk or of some other job in the accounting department. It may also be an entry job for a trained calculating-machine operator.

Payroll clerks may find it difficult to move upward in the accounting department without further training. They may, of course, hope to become head of a payroll section in a large company, but such opportunities are not numerous.

Posting Clerk (Ledger Clerk)

The accounting department works as a team, with the staff relying on each other to do their share properly. Posting clerk is a minor position but mistakes or carelessness at this level may cause extra work for others.

Posting clerks make simple entries in ledgers or on special forms, taking the information from other accounting records. They total the columns of figures in the ledgers either daily or at regular intervals, and may use adding or calculating machines. They usually type the column headings on ledger sheets or special accounting forms.

At least two years high school is required of posting clerks. An additional one-year business course with emphasis on bookkeeping is preferred, although the ability to distinguish between a debit and a credit will often suffice for entry. An elementary knowledge of typing is an asset.

Posting clerk may be an entry occupation or a promotion from one of the junior levels. Whenever a vacancy occurs, a file clerk,

mail clerk or office boy or girl, who has the potential ability, may be promoted to the job.

This position may lead to a number of other accounting jobs, depending on the extent of the division of work. The posting clerk may move upward to bookkeeper in charge of accounts payable or accounts receivable and then to head bookkeeper.

Other opportunities for advancement occur when an employer decides to mechanize some bookkeeping operations. Training may be given on the job, or the clerk may be sent to the machine company for a short instruction period in machine operation.

ACCOUNTING MACHINE GROUP

The machine occupations which are most easily recognized as accounting or bookkeeping occupations are: *bookkeeping-machine operator, billing-machine operator* and *calculating-machine operator.*

This group of occupations has much in common and is, therefore, treated separately only where there is a significant difference, as in the description of duties and advancement.

Hand and finger dexterity and good eye-hand co-ordination are of prime importance in these occupations. Good eyesight is needed. Accuracy and speed in working with figures and an aptness for spotting inconsistencies are necessary. Also needed are above-average clerical ability and a good memory for detail.

Two years of high school is usually required, with junior matriculation desirable. The student should acquire an elementary knowledge of bookkeeping and typing.

Business schools offer courses in office machine operation, and the machine manufacturers maintain training centres in the large cities across Canada.

Applicants for these courses may be given ability and aptitude tests to indicate their chances of success in the occupation of their choice. These tests may range from a short clerical test, including elementary arithmetic, to a bookkeeping questionnaire, an arithme-

tic test on a third-year high school level, and a mechanical aptitude test. Trainees may be on trial for a short initial period of the course. Reliable schools reject all unsuitable applicants after this initial try-out.

Instruction in many of these schools is on an individual basis; the duration of the course is, therefore, determined by the learning capacity of the student. Courses in bookkeeping- and billing-machine operation average four to five weeks of day classes or four to five months of evening classes. Calculating-machine courses may extend from nine to sixteen weeks in the day division or six to nine months in the evening. Fees range from $90 to $125 for the complete course.

Some employers give on-the-job training on these machines but such training is usually restricted to one phase of the machine work and does not turn out a qualified operator. On the other hand, qualified operators adapt easily to different makes or machines from the one on which they receive their initial training.

On successful completion of an office machine course, the student is given a diploma which, if it is from a reputable school, may open the door to many employment opportunities. The machine manufacturers' training centres have a placement service because of their contact with firms that use their machines.

As a rule, these office machine operators work in a medium-sized or large accounting department with other bookkeeping clerks. A normal amount of noise and distraction is to be expected.

Bookkeeping-Machine Operator

The bookkeeping-machine operator is able to take over work formerly performed by hand and do it with much more speed, accuracy and neatness.

The duties of a bookkeeping-machine operator are similar to those of a bookkeeper, except that the work is performed by setting up and operating a bookkeeping machine. As with the bookkeeper working by hand, the work may be subdivided, as Bookkeeper (Accounts Payable) or Bookkeeper (Accounts Receivable).

Junior clerks are seldom promoted to the position of bookkeeping-machine operators except for training on only one phase of the work, but billing-machine operators occasionally have the opportunity to learn the complete duties of the bookkeeping-machine operator. Promotion for bookkeeping-machine operators is somewhat restricted, as training and experience in machine operation is rather specialized. Where several operators are employed, there may be an opportunity to become supervisor.

Billing-Machine Operator

The billing-machine operator does all the necessary billing by machine. The operator sets up and operates a machine on which she prepares bills, invoices and statements to be sent to customers. She calculates extensions and additions, using a calculating unit which may form part of the machine. She may also type information on bills and invoices using a typewriter keyboard on the machine.

The position of billing-machine operator may be a promotion for a typist. She may be trained on the job or sent to the machine manufacturer's training centre for one or two days for a brief instruction period in one phase of the work.

The billing-machine operator may be promoted to the position of bookkeeping-machine operator. This is often a gradual process of training on the job and helping or replacing a regular operator on occasion. It usually means extra work with no prospect of a salary increase during the training period.

Calculating-Machine Operator

Although many machines may be included in the broad term "calculating machine", this section deals specifically with those which have figure keyboards of approximately one hundred keys. A well-known example is the Comptometer.

Calculating-machine operators work on machines with figure keyboards to compute, check or verify calculations. They may work on inventory and payroll computations, invoice extensions, work sheets, financial statements, discount and interest, costing or any other statistical work. Other duties may include posting and filing.

Calculating-machine operators who take an intelligent interest in the work and endeavour to understand reasons for the calculations, may soon find their interest drawn to one particular phase of the work. They may then be able to decide if further study along that line will be useful to them. They should, before going to any expense, discuss the matter with an immediate supervisor or with a member of the personnel department. At times, practice and familiarity with the work will be sufficient to merit promotion.

Where there are a number of calculating-machine operators, and a section is set aside for them, an operator may become head of the section, but such opportunities are not numerous.

Other positions they may hope to obtain in time are: payroll clerk, statistical clerk or cost accounting clerk. In order to work as a cost accounting clerk, however, further studies at university level are usually required.

Calculating-machine operators complete, check or verify calculations.

TABULATING-MACHINE GROUP

Toward the end of the nineteenth century, Dr. Herman Hollerith invented the forerunner of our present-day punch-card-tabulating system. Dr. Hollerith's idea then was to speed up tabulation of the census. Today, many large business firms and government offices depend on punched-card data to supply them quickly with the latest statistics for the formulation of future policy.

The Tabulating Group is divided into two sections:

1. Key-Punch and Verifying Operators.
2. Tabulating-Machine Operators.

It is possible for the key-punch and verifier operators to do some tabulating work, but generally there is a distinction between the two sets of duties. Most key-punch operators are women and, on the other hand, most tabulating-machine operators are men. Generally, work proceeds from one operation to another as follows: information transferred to cards on the key-punch machine is checked for errors on the verifier. The sorting machine selects cards according to a pre-determined characteristic, or arranges them in numerical or alphabetical sequence. Tabulation then provides the desired statistics.

Stages in Data Processing

$$\begin{tikzcd} \text{Original documents} \arrow[d] & \text{Statistics} \\ \text{Key Punch} \arrow[d] & \text{Tabulating} \arrow[u] \\ \text{Verifier} \arrow[r] & \text{Sorting} \arrow[u] \end{tikzcd}$$

The occupations in this group will be treated separately only in the description of duties.

As with the accounting group, hand and finger dexterity, good eye-hand co-ordination, and good eyesight are of prime importance.

Mental alertness and ability to grasp new ideas quickly are necessary. Emotional stability is essential because of periodic pressure of work.

These machine operators, more than those of any other category, are likely to work in a group in a separate room. There will be more noise but the room may be sound-proofed and their working conditions equal to, or better than, those of other office employees. Supervisors are usually more lenient with employees who work under conditions which may create nervous tension.

This group of machine operators is either trained on the job or sent for training to the company servicing the machines.

The learning period depends on the complexity of work performed on the machine and the number of machines which form part of the specific job. The period varies from three months to two years.

For alphabetic key-punch and verifier machines the employer, as a rule, chooses a typist for training. On numeric machines he may choose an employee who is adept in the operation of adding or calculating machines.

Tabulating-machine operators are usually trained separately from the key-punch group, depending upon the size of the installation. They may be expected to wire panels which control the machine operation.

Should an integrated data-processing system ("automation") be installed, the tabulating-machine operator would be a logical choice for special training on new procedures.

Key-Punch (Card-Punch) Operator

These workers operate machines with alphabetic keyboards similar to a typewriter, a numeric keyboard, or a combination of both. By depressing the keys on the machine, they punch holes in cards to transcribe information to them, in coded form.

They may operate verifier, sorting, and tabulating machines. Other duties include filing.

Verifier Operator

The work of these operators closely resembles that of the key-punch operator. Although operated in the same manner as the key-punch, this machine does not punch holes in the cards—it checks previously punched cards for errors.

Sorting-Machine Operator

These workers operate machines that automatically sort punched cards into any desired series or classification. They place punched cards in feeders, set the machines to sort the cards as required, and remove sorted cards from the bins in proper sequence.

They may also operate verifier and tabulating machines, and may do some filing.

Collating-Machine Operator

This machine requires panel board wiring and its prime purpose is to collate and sequence-check punched cards.

Key-punch operators transcribe information to cards in coded form.

Calculating-Machine Operator

This machine requires panel board wiring and can perform multiplication and division for any sequence of mathematical requirements.

Tabulating-Machine Operator

This machine requires panel board wiring and from the punch-card information lists card totals, and generally transfers the punch-card information to printed information.

Depicted above is a tabulating installation. The units, from left to right are: keypunch (and operator); sorter (below the clock); tabulator (and operator); and reproducer.

ELECTRONIC DATA PROCESSING GROUP

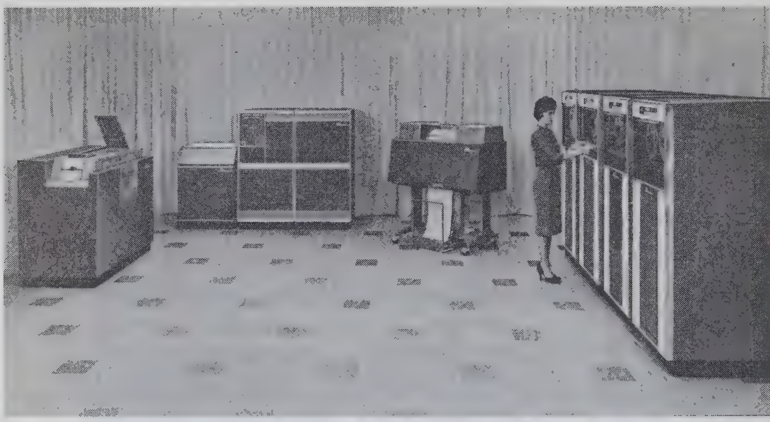
Increases in size and complexity of many business and industrial organizations have brought about an ever-increasing tide of costly and time-consuming "paperwork". Efforts to cope with this paperwork, until recently, have largely consisted of streamlining operations within the existing framework of office organization and of the introduction of various types of mechanical and electrical equipment already discussed.

Within the past ten years, electronic computers have entered into office operations. This equipment has made possible the mass processing of data—known as electronic data processing or EDP—on a scale never before attainable. An office with an EDP system can accomplish a great deal of clerical work with a corresponding decrease in clerical staff and the accuracy of the work is increased.

Introduction of the computer has created a group of new occupations and has altered duties in existing ones. The numbers and kinds of personnel in EDP depend on the data being processed and the equipment in use. However, most companies use computers to process large masses of data and the following paragraphs will cover basic occupations when the equipment is used for this purpose. These will include systems analyst, programmer, peripheral machine operators, console operator and tape librarian.

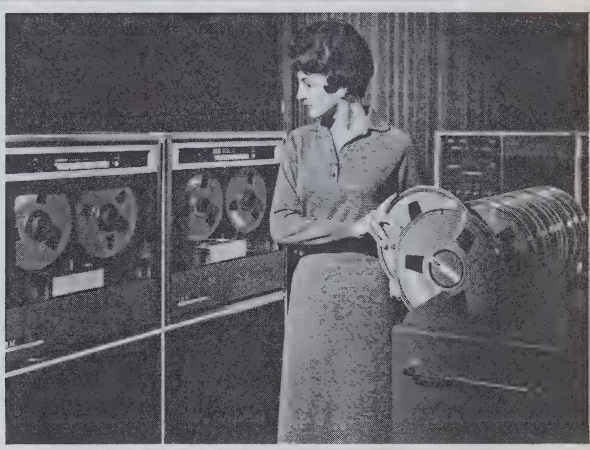
Electronic data processing is carried out by a computer which has a number of peripheral (auxiliary) units. The computer is an advanced calculator embodying electronic and electro-mechanical controls which not only perform at the fantastic speed of electronic impulses—as many as 240,000 subtractions or additions per second—but also has a "memory" in which facts and instructions can be stored and later used by the machine in carrying out its tasks.

There are two main kinds of computer: "digital" and "analog". The digital computer is used to speed up many record keeping functions in business and industry. These include such activities as payroll accounting, market research, billing, scheduling and inventory control and the accounting functions in financial institutions such as banks and insurance companies. Other diverse applications include reservations, routing and traffic allocation in the transportation fields, controlling production lines in factories and scientific problems including guidance of the larger rockets.



Above:

A medium sized computer installation



Right:

This unit transfers information from punched cards onto magnetic tape

Left:

A high-speed printer used to translate coded information from magnetic tape into words and figures

On the other hand, the analog computer is generally used as a tool to solve specialized scientific, technical and research problems; the personnel have somewhat different duties and are not included in this booklet.

Computer installations vary considerably in size and appearance; some are as small as an office desk while others will fill a large room. However, they are similar in that they all consist of three main elements: input, processing and output.

The input consists of the data to be processed and instructions which have to be analyzed to tell the machine what to do. This data may be in one of several forms: punched cards; perforated paper tapes; magnetic tapes; or direct wire input from remote locations.

The processing unit consists of a console (or control centre), a storage or "memory" section and the processing or arithmetic section.

Input to, or output from, the computer has to be translated from machine language into numbers and words. This is achieved through printers directly connected to the computer or, particularly where the operations are high speed, through tape-to-card converters, high-speed printers and similar peripheral equipment.

Tapes or cards used in processing data are stored after use and are often used over and over again—as, for example, in making up weekly payrolls.

At the present time, computer occupations are with companies large enough and with a sufficient volume of work to justify costs of the equipment. These are in main population centres where the head offices of large business organizations such as banks, insurance companies, wholesale and retail companies and manufacturing concerns are chiefly located. Other opportunities will be found in government establishments and with companies who provide computer services on a fee-paying basis.

PLANNING

Systems Analyst

Detailed studies of a company's operations and of the departments within that company are undertaken by *systems analysts* (or methods analysts). This is to decide where and how the company can improve work methods by electronic data processing and, if necessary, to recommend the most suitable equipment.

Working in conjunction with departmental heads, such as the chief accountant and the stores and purchasing manager, the systems analyst will institute new computer applications, or revise existing ones, and broadly define the methods of processing the company's data.

Depending on the size of the company and the results required, the systems analyst will prepare block diagrams showing the sequence of main operations to be done by the computer installation, although on smaller installations this may be the work of a programmer. Forms associated with electronic data processing are designed, operations and procedures manuals prepared, and company officials are instructed in the use of the installation.

The systems analyst may also perform duties which in some installations are undertaken by the programmer. These include the development of programs for the more complex operations and scheduling use of the computer to keep the machine operating on a full-time basis.

Programmer

Even though computers are sometimes called "electronic brains" they can only follow instructions carefully prepared for them. Each project must first be analyzed to determine the most efficient methods for the job in hand; this may be the work of the systems analyst or programmer again depending on the problems involved.

After initial planning has been completed, the *programmer* prepares a "program" or detailed plans for processing the data through the computer. Certain information is obtained from other departments of the company. In making up a payroll, for example, the programmer must obtain wage rates, hours worked, and determine how this information is entered on company records.

Having obtained this basic information together with full details of the nature of the project, the programmer prepares a "flow chart" or diagram showing the sequence in which the computer must perform each operation. For each operation shown on the flow chart, he then prepares detailed instructions which are transferred to the memory section of the computer to tell the machine how to process the input data and how to arrive at an output solution.

These instructions are normally translated into a numerical code—the language to which the machine can respond—and often this coding is the work of the programmer.

Finally, the programmer must verify the accuracy and completeness of his work. To do this, he prepares sample data, makes trial runs, and compares the results from the computer with those obtained by other means.

The programmer also prepares instruction sheets for a console operater to follow during production runs.

OPERATING PERSONNEL

Operators trained to run several different kinds of equipment are employed in data processing. They either operate the console of the computer or the peripheral machines which convert facts and figures into the special code required by the computer. Data fed into the computer may be in one of several forms: punched cards prepared by *keypunch operators;* paper tapes prepared by *bookkeeping* and *billing machine operators;* cards or tapes prepared on typewriters with special attachments by *typists.* (Operators of accounting and tabulating machines, and typists are described in other sections of this booklet.)

Peripheral Equipment Operators

Information may be fed into the computer systems directly from the tapes or cards previously mentioned. However, the fastest systems receive their input from magnetic tapes. Conversion machines such as card-to-tape converters, and tape-to-tape converters are therefore required and these are run by *peripheral equipment operators.* Auxiliary equipment, which also includes high-speed printers, are part of the electronic data processing system but are usually operated independently of the computer. In many

large installations, the auxiliary equipment is frequently a smaller "satellite" computer.

To set up a machine, operators require a good general knowledge of how the system operates. They ensure that the machines function correctly by observing warning lights on the machine and remedy minor defects or report to others as they arise. Some of this equipment is relatively difficult to operate and workers may specialize in one type of machine.

Console Operator

When data has been converted into the form acceptable to the computer, it is ready to be processed. This is the work of the *console operator* who, seated at the central control panel (the console), manipulates control keys and observes indicator lights during the run. He reviews the instruction sheets prepared by the programmer, loads the computer with tape or cards, and starts the run.

Defects which arise from time to time such as program or operator errors, tape breakage or machine failure will be shown by the indicators. When this occurs, the console operator will try to locate the cause and will either remedy the defect or request the services of the programmer or the maintenance engineers. He also keeps records of the time taken for various projects, the amount of time when the machine was stopped and the reasons for stoppage.

Some console operators do fairly standarized work: others may have considerable responsibility. They may work with systems analysts and programmers in developing and testing new programs and routines and also supervise the work of peripheral equipment operators and tape handlers.

Tape Librarian

Magnetic tapes must be stored before and after they have been run on the computer and this is the work of the *tape librarian.* This position is usually found only in large installations; in others it is done by the console operator or other equipment operators.

The librarian keeps records such as data on the tape, when the tape is used and how it is used, and such other information as will add to the efficient cataloguing of the material and allocation of tapes for re-use.

EDUCATION AND TRAINING

Administrative personnel in electronic data processing are, at the present time, specialists with a relatively high standard of formal education. Usually they are university graduates in mathematics, accounting and business administration or have the equivalent work experience in such fields as accounting or inventory control. Following this education, considerable experience on the actual equipment is required and often this training is provided by the equipment manufacturer. Some universities provide courses in the general field of electronic data processing and it is probable that these courses will be extended as increased use of computers is made.

Education and other training requirements for operating personnel will vary with the type of work and the problems involved in a particular company. Also, job requirements are changing—there is a move towards simplifying certain operations—and this will affect future education and training requirements. Many employers have filled their operator positions by selecting operators from other departments such as the accounting and tabulating group and who may be no longer required when a computer is installed. New entrants, however, to be considered, require high-school graduation as a minimum and employers may require university training for some positions.

Computer manufacturers are extremely active in the training of personnel. They not only install equipment but also provide comprehensive training programs for the personnel who are to operate the equipment.

There are also some private schools which offer courses in the operation of tabulating and key-punch equipment. Several of these schools have expanded their courses to provide the elements of computer programming.

WORKING CONDITIONS

Operating personnel work in modern, well-lighted, dust-free and air-conditioned offices. Machine noise however will be experienced when the various machines are in operation.

Planning personnel who may work away from the computer installation will be under the conditions prevailing in other departments of the company and, at times, these may be somewhat crowded.

Hours of work per week, vacations, and benefits such as medical and pension plans are similar to those provided for other office workers. Smaller computer installations, however, may be used on day shift only and in this case, considerable overtime can occur. Larger installations may work on a two- or three-shift basis and operating personnel can expect day, evening and night shifts.

Day periods are usually worked by administrative personnel although they may be called at any time when the computer is in use—night or day—to solve programming or other difficulties.

ADVANCEMENT

Operating personnel, as they gain experience, may be assigned to operate more complex equipment. Eventually they may rise to supervisory positions or jobs which combine supervision with console operation.

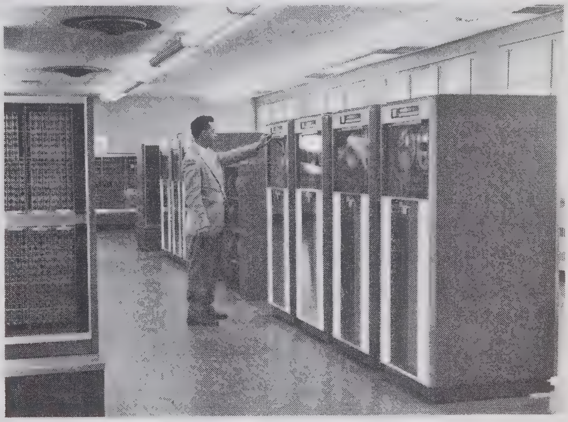
Console operators, through on-the-job training can acquire a knowledge of programming techniques and may be selected by their employers for the position of programmer.

With sufficient experience and demonstrated ability, the programmer may be promoted to a supervisory position, to systems analyst or to other management positions with the company.

How Will EDP Affect Office Workers?

In order to make full use of electronic data processing as it is conceived at present, considerable re-organization of the office staff may be necessary. Traditional lines of communication, functions and responsibilities, as shown on page 18, may have to be altered or abandoned to make way for a new concept of integrated office operation utilizing electronic data processing equipment.

The centre console with processing and magnetic tape units in the background



A bank of magnetic tape units which form part of the computer installation

The tape librarian is responsible for the maintenance of the files of magnetic tape used to store computer input and output data

A clear picture of the "automated" office has not yet emerged, but there are broad indications of what may happen to various groups of clerical functions. It is likely that repetitive hand work (calculating and preparing pay rolls, making bookkeeping entries, filing, etc.) may be eliminated to a great extent.

Occupations least affected by EDP will likely be those requiring considerable judgment or contact with other people, such as those of secretary and receptionist. In other occupations, that of typist, for example, the addition of tape-writing attachments to the typewriter transforms it into a "feeder" machine for the computer unit, but leaves the basic operation unchanged. Key-punch operators and coding clerk occupations have also been brought into EDP systems without any basic change in duties. Computer peripheral units which will "read" typewritten documents are reducing the requirements for manual recording, such as key-punching, and the typist-punch operator will concentrate more on off-standard documents.

Distinctly new occupations have appeared as a result of EDP but are still in the process of change. A period of stabilization will be necessary before career opportunities can be identified, and more research is needed to determine what training or retraining will be necessary for the new functions.

The effect that EDP will have on existing office staffs, or on young people now training for office work, will also depend on how widespread its adoption is, and the speed with which it takes place. Thus far in Canada, it has been installed in about 275 establishments in varying degrees. The high cost of EDP equipment, and the considerable planning and re-organization often necessary for installation, tends to restrict its use to only very large firms in which clerical work is heavy. Some firms, out of sheer necessity, will be forced to adopt EDP in order to cope with their expanding operations. It is possible, however, that EDP services on a part-time rental basis, or the use of "junior" size equipment, may make it profitable for small firms to consider.

We are truly on the threshold of an electronic era in office operation. Only dim suggestions of the things to come are discernible at present. The office as a control and information centre will prob-

ably play an increasingly important role in the conduct of the nation's business and services. We may expect eventually a sharp reduction in many routine and repetitive clerical jobs and a relative increase in jobs requiring good educational background and special training.

Due to the different methods of reporting pay scales, the figures given in the following Tables are approximate only and are included for general guidance. Pay scales frequently change, are subject to geographical differences and vary with the degree of responsibility. The reader should refer to the National Employment Service, local employers, union officials, newspaper advertisements, and government publications such as WAGE RATES, SALARIES AND HOURS OF LABOUR IN CANADA, *Department of Labour, Canada, for current rates in a particular area or company.*

AVERAGE WEEKLY RATES
October 1962

OFFICE OCCUPATIONS	St. John's, Nfld.	Halifax, N.S.	Sydney, N.S.	St. John, N.B.	Montreal, P.Q.	Quebec, P.Q.	Ottawa, Ont.	Hamilton, Ont.	Toronto, Ont.	London, Ont.	Winnipeg, Man.	Regina, Sask.	Saskatoon, Sask.	Calgary, Alta.	Edmonton, Alta.	Vancouver, B.C.	Victoria, B.C.
Female	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Accounting clerk, junior	41	51	48	45	52	45	55	57	55	48	55	62	55	56	52	56	58
Accounting clerk, senior	60	61	—	64	73	64	75	71	73	63	79	75	76	75	67	74	77
Billing machine operator	44	45	48	51	55	47	50	52	59	49	53	54	50	56	51	60	55
Bookkeeper, senior	61	64	60	61	77	58	69	69	77	69	67	77	74	69	68	79	71
Bookkeeping machine operator	46	47	44	46	55	46	55	53	57	51	51	54	52	52	50	54	52
Calculating machine operator	48	52	—	45	59	50	62	59	60	51	54	58	52	57	55	63	55
Clerk, junior	43	41	40	38	46	42	48	50	50	46	42	46	46	45	51	50	45
Clerk, intermediate	51	47	49	51	59	57	60	59	61	53	52	60	57	57	57	64	59
Clerk, senior	75	55	60	61	74	60	78	74	74	68	65	72	70	69	68	72	66
Cost accounting clerk, junior	—	49	—	—	58	46	52	63	59	52	—	55	—	60	56	55	53
Cost accounting clerk, senior	—	64	—	—	73	—	76	76	73	67	54	—	—	69	72	72	—
Filing clerk	49	38	—	41	44	42	46	46	49	43	43	53	54	47	44	49	47
Keypunch operator, junior	—	51	—	—	54	45	50	55	56	47	50	52	—	58	56	59	46
Keypunch operator, senior	—	52	—	58	63	55	62	64	63	56	56	65	—	66	69	66	53
Material record clerk	50	47	—	46	55	44	53	57	57	50	49	52	48	54	49	57	53
Order clerk	37	44	—	48	61	53	60	58	64	54	48	58	54	57	54	71	61
Payroll clerk	52	53	57	54	63	48	66	60	66	56	57	65	62	68	60	66	63
Secretary, junior	49	57	53	50	71	59	68	72	70	63	63	62	56	71	59	63	63
Secretary, senior	64	66	70	64	81	71	80	78	80	72	73	76	70	80	72	77	73
Stenographer, junior	43	47	46	46	56	46	54	57	58	52	50	57	52	56	53	54	58
Stenographer, senior	59	58	55	59	68	60	66	68	67	62	61	64	63	66	64	64	57
Tabulating machine operator	—	58	—	—	66	51	64	71	65	55	55	—	—	65	71	71	—
Telephone (switchboard) operator	38	49	48	44	56	46	51	57	59	52	49	53	52	55	52	56	54
Typist, junior	41	45	43	41	48	43	50	50	51	47	44	47	48	48	48	48	45
Typist, senior	52	50	46	52	58	50	61	59	60	54	52	61	55	58	56	59	53
Male																	
Accounting clerk, junior	55	55	64	57	59	59	59	62	65	57	62	62	56	70	65	64	63
Accounting clerk, senior	87	82	86	85	92	96	89	97	94	82	88	82	82	99	92	98	91
Bookkeeper, senior	81	85	95	89	98	88	95	101	103	89	86	94	87	104	101	102	94
Clerk, junior	50	45	50	42	53	49	53	56	55	49	46	50	52	58	57	51	47
Clerk, intermediate	61	63	73	65	73	68	70	84	73	67	65	68	67	79	74	77	69
Clerk, senior	87	86	83	92	97	89	92	105	96	87	85	93	89	105	97	102	90
Cost accounting clerk, junior	49	72	75	57	67	67	63	72	70	64	52	61	66	79	64	76	73
Cost accounting clerk, senior	85	91	91	85	98	100	86	100	96	87	73	78	81	97	87	105	87
Material record clerk	65	64	71	72	74	75	71	84	75	73	73	78	72	81	77	82	77
Office boy	37	37	32	37	41	41	39	46	47	45	42	45	44	45	46	45	—
Order clerk	68	69	68	68	80	71	77	90	82	76	67	69	68	76	73	85	79
Payroll clerk	63	64	73	75	77	77	77	82	79	67	72	86	67	82	81	87	80
Tabulating machine operator	—	76	—	—	77	78	69	77	75	67	70	78	—	77	76	82	—

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared the following filmstrips in collaboration with the National Film Board. These may be purchased from the National Film Board, Box 6100, Montreal. Prices in Canada: $4.00 for colour; $2.00 for black and white.

Plumber, Pipefitter and Steamfitter (b & w)
Careers in Engineering (colour)
The Social Worker (b & w)
Bricklayer and Stone-mason (b & w)
Printing Trades (b & w)
Careers in Natural Science (colour)
Careers in Home Economics (b & w)
Motor Vehicle Mechanic (b & w)
Mining Occupations (b & w)
Draughtsman (b & w)
Careers in Construction (b & w)
Machine Shop Occupations (b & w)
Sheet-Metal Worker (b & w)
Careers in Meteorology (b & w)
Medical Laboratory Technologist (colour)
Teacher (colour)
*Office Occupations (colour)
Electrical and Electronic Occupations (colour)
Careers in Library Service (colour)
Electronic Computer Occupations (colour)

**A visual presentation of the essential facts in this booklet.*

OFFICE OCCUPATIONS

Monograph No. 46

CAREERS IN LIBRARY SERVICE

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Canadian Occupations
Monograph 47

CAREERS IN LIBRARY SERVICE

Prepared
by the
Economics and Research Branch
of the
Department of Labour, Canada

HON. MICHAEL STARR
MINISTER

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DEPUTY MINISTER

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FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada and from other quarters.

The CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This booklet was prepared for the Manpower Resources Division by Miss Mary Stuart and William Allison of the Occupational Analysis Section. The Department acknowledges the kind assistance of librarians of the National Library, Dominion Bureau of Statistics, Toronto Public Library, Ontario Provincial Library Services, Canadian Library Association, Special Libraries Association (Toronto) and the Director of the Library School of the University of Toronto. Miss Margaret Parkin, Branch Librarian for the Department of Labour Library, gave invaluable assistance in the course of preparation.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

January 1962

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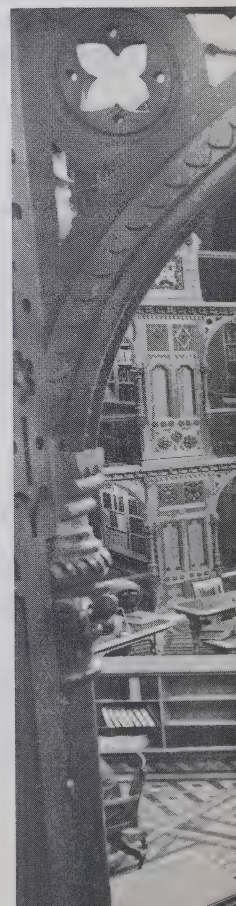
Interior of the Library of Parliament, Ottawa, as it appears today. Having survived the disastrous fire which destroyed the Parliament Building in 1916, it was itself damaged by fire in 1952. The library houses over 300,000 books, including some rare and valuable collections. Library services are for members of parliament and individuals doing special research.



CAREERS IN LIBRARY SERVICE

Libraries are "the memory of the human race". In them are stored recorded thoughts and ideas of present and past generations in the form of books, manuscripts, music, art, film and other works. Modern libraries combine the development and maintenance of these collections with a service designed to meet the needs of the community for information, education and recreation.

Librarians, assisted by library clerks, plan, organize and administer these services.

Photo: NFB

LIBRARY SERVICES AND HOW THEY GREW

Libraries date back to the development of writing. Archeological diggings have unearthed traces of some that existed as far back as the days of Babylonia. Clay tablets bearing accounts of law, business, history and religion, all carefully tabulated and preserved by early librarians, record the glory of past civilizations.

In early Western culture, monastic scholars collected and preserved the works of classical writers—Virgil, Horace, Homer—as well as religious literature, many on carefully illuminated manuscripts. The advent of printing, followed later by the introduction of universal education, created a larger reading public and books gradually became cheaper and more plentiful. This was the beginning of a deluge of printed material that has increased year by year, creating the need for people skilled in systematic collecting, cataloguing and putting to use the vast amount of literature and printed material now available.

Books were scarce in Canada during early days of settlement, although as early as 1606 Marc Lescarbot, a Paris lawyer living in Port Royal, loaned books from his personal library to friends. In 1635, Bishop Laval's personal library was the beginning of *La Bibliothèque du Collège des Jésuites de Québec,* and in 1791 John Graves Simcoe donated his library to the Legislature of Upper Canada. Other benefactors followed and gift collections continued to enrich or found Canadian libraries.

It was logical that libraries would be formed in universities and colleges for the use of students and faculty members. Also, various subscription libraries appeared in larger communities. Among such private libraries were the Library Association (a subscription-library chain) and the Mechanics Institute. The Institute was an outgrowth of a British system designed for the self-improvement of the working classes, the beginning of what we now call Adult Education. In Canada these libraries extended their facilities to serve communities which otherwise would have had no library. The Institute established book collections and organized study classes and lectures for members on a fee basis, the first being opened in St. John's in 1827. As educational facilities improved, the Institute concentrated more on its libraries, which later became the basic collections of many municipal public libraries.

Publicly supported library service is now provided for by legislation in all provinces and in 1952 provision was made for the establishment of a National Library in Ottawa. This is operating from temporary quarters until a suitable building to house our national collection can be built.

Today, there are some 3,200 libraries in Canada. This total is made up of public libraries, government libraries, professional, business and technical libraries, as well as those in universities and schools. If the many branches of these were counted the total would be much larger.

Employed in supplying library services are more than 5,600 men and women, of whom about 30 per cent are professionally trained.

LIBRARY PERSONNEL

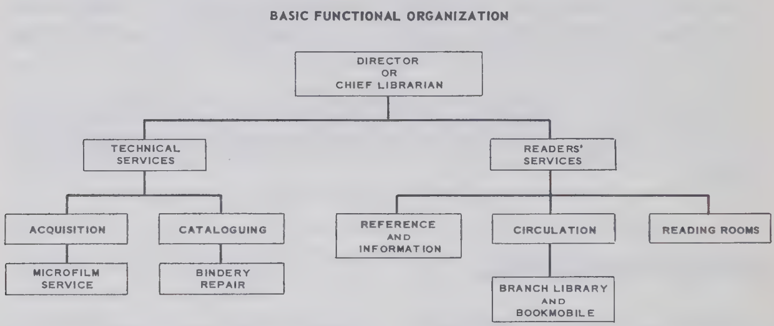
Libraries vary considerably in size from small collections administered by one person to large departmentalized establishments with a number of branches and employing a hundred or more workers. They also vary in their function and purpose—from the public lending libraries you know so well to highly specialized libraries designed to serve the needs of special groups such as the blind, music-lovers or scientists.

Librarians are key persons in a modern library. They direct, supervise or carry out the functions of a library and its various departments and branches. Assisting them are groups of workers who, for want of a standard designation, we will call *library clerks*. These library clerks are responsible for the many routine tasks of library service. *Pages*—young people who work after school hours, during holidays or week-ends—are often employed to fetch and carry for the regular staff.

It should be pointed out that a few occupations carrying the title "library" or "librarians" are not included in this booklet. Among these are *medical records librarians,* who keep hospital medical files in order, and *tape librarians,* who look after tapes and programs for electronic data processing systems. These are not library workers in a strict sense and will be dealt with in other booklets in the CANADIAN OCCUPATIONS series.

NATURE OF THE WORK

All organized libraries must carry out certain basic activities if they are to grow and function efficiently. The chart below indicates, in a general way, how library work consists of two main or basic services, which may be subdivided into further specialized services, depending on the size of the library and its purpose.



Organizational Chart

Chief librarians or *directors* undertake, within their authority and budget, the management of library services. They must be familiar with the needs and tastes of the people being served and leaders in developing and broadening these tastes. Chief librarians are responsible for public relations, represent the library at meetings, public gatherings and on committees, and may give talks on subjects related to the work.

Technical Services

These include acquisition of new or replacement material and the classifying, cataloguing and indexing necessary to bring the new material into use. Binding and repair of worn or damaged material is also a part of the service.

Librarians in charge of technical services, and their supporting staff, work behind the scenes, almost unknown and unseen by the clients they serve. Yet without their constant effort, the library would stagnate and service would soon become haphazard and ineffective.

Acquisitions

Librarians in charge of acquiring new material must be closely tuned to the needs of library clientele. It is essential to obtain a good selection of subjects and to keep purchases within the annual budget provided for acquisitions. They search publishers' and second-hand dealers' catalogues, book reviews or publications indexes for new or out-of-print material in the form of books, periodicals, manuscripts, art, recorded music, film, microfilm, or government documents. They may also scan and review new books received from publishing houses.

New books are catalogued as they arrive at the library.

Photo: NFB

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Cataloguing and Classifying

Librarians are responsible for cataloguing and classifying all newly acquired material. This is the careful recording, on cards, of title, author, description (size, illustrations, etc.) and a short outline of contents. They assign a classification or *call number,* indicating the subject matter and where it is located on the shelf, and maintain a card system (the *catalogue*). For their own use, they usually establish *authority files* to assist them in verifying such things as author's full name, where he has used various forms of it or a pseudonym, date of birth, titles of works, and the source of their information.

In libraries where a great amount of this work is done, librarians may specialize as *cataloguers* or *classifiers*. Lately, with the increase in volume of printed technical and scientific material, greater attention is being given to the problems of cataloguing and classifying difficult and complex subject matter. This is an area in which further research and study offers librarians scope for professional development.

Cataloguing requires attention to detail, exactness, and a good background of both general and specialized information, as well as skill in cataloguing techniques. A knowledge of several languages is a great advantage in dealing with foreign material. Cataloguers must be able to scan great quantities of printed material, analyse it quickly and pick out main themes and facts.

Cataloguing clerks may help to check, prepare catalogue cards, mark material with catalogue numbers, and otherwise prepare it for use on the shelves.

Bookbinding and Repair

Bookbinding is a specialized craft that is more closely related to printing.[1] A few libraries have their own bookbinding sections and employ bookbinders but, unless there is a great volume of work to be done, it is sent out to a commercial firm.

Many libraries have repair shops where damaged or worn books are restored, pamphlets are bound or put into binders, covers on

[1]CANADIAN OCCUPATIONS Booklet No. 9, *Printing Trades.*

new books are shellacked, and clippings are mounted in folders or books. Junior clerks and pages may be employed at this work, although there is need for skilled workers in restoring old and valuable items.

Readers' Services

Modern libraries are much more than mere collections of books standing neat and orderly on shelves. To be of value, the collection must be put to use, and the use made of the collection is determined to a great extent by the efforts of staff rendering service to the readers.

Library staff engaged in providing readers' services generally have more direct contact with the clientele than those engaged in technical services. Although some of the work is straightforward or routine, there is also tremendous opportunity for professional staff to exercise originality and resourcefulness, thus enhacing the value of the library collection to its clientele. They may get to know their clientele with regard to individual tastes and interests, use this knowledge to expand the library collection in the most useful areas, and publicize new additions to the collection.

In large libraries, readers' services may be carried out according to the following divisions: Circulation Department, Reading Room, Reference and Information Services, and Branch Libraries.

Circulation Department

Some systematic arrangement for library clientele to borrow and return material exists in most libraries. It usually consists of a procedure for issuing borrowers' cards and recording material borrowed and returned.

There is a strong clerical flavour to this part of the work. Much of it involves checking dates, assessing fines for overdue books, making entries on loan cards, sorting cards, making out new ones, replacing books on shelves and keeping stacks in order. Some libraries which handle a large volume of circulation work have installed photographic charging equipment. This reduces time-consuming work at busy circulation desks and speeds up service. Library clerks later process film records from the photocharger.

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Photo: NFB

Books are checked out at the circulation desk.

It often occurs that readers come to a library not knowing precisely what they want or where to find it. Librarians are expected to help determine what is required, suggest possible sources, and assist in locating them. If a particular item is not carried in the collection, the librarian may refer to the Union Catalogue of the National Library to see where it can be obtained.

Reading Room

Many libraries have one or more reading rooms containing newspapers, periodicals and other current material, and certain reference works. Librarians are in charge of the room but usually a library clerk is on duty to keep it in order, to enforce regulations and, in

addition to these custodial duties, may keep busy making out membership cards or some other routine work. Each day certain changes are made in current material and the replaced items sent to general circulation or for storage.

Reference and Information Services

Essential to this service are skilled and knowledgeable librarians, versed in the use of standard reference materials, familiar with the literature of the field and with outside sources of information. Their prime duty is to assist research workers, students, teachers and others, answering questions and helping to locate additional information. They prepare indexes and bibliographies on selected subjects (*bibliographers* are specialists in this work), keeping up to date files of clippings, reports, abstracts and other material dealing with general or specific subjects and advising the Acquisition Department of needed materials.

Reference rooms provide material and atmosphere for serious study.

Photo: NFB

With the increased volume of published material, particularly in scientific and technical fields, and increased research activity, reference services have become an important library function.

There may be an information desk or section where telephone calls or written or verbal requests for information are received. The librarian in charge of information services handles difficult or unusual inquiries. More routine questions requiring straightforward replies may be passed to clerical staff.

Branch Libraries

Need for library services often arises in locations some distance from the main or central library. This is particularly true of public libraries in large cities, and in government departments or universities. Branch libraries are simply an extension, in a more convenient location, of the main library. The librarian in charge functions as a department head to provide all readers' services, usually

Bookmobiles extend library service to schools and community centres.

Photo: NFB

Photo: Ontario Department of Education

drawing upon the main library for technical services, as well as for material not carried on branch shelves.

Bookmobiles—mobile branch libraries—are an extension of readers' services peculiar to public libraries. They provide service to school children or the general public in both rural and urban communities, stopping at schools, shopping or community centres, or any gathering point in new communities or sparsely settled areas which can be reached easily by road. Bookmobiles are specially outfitted vans or trailers stocked with books and driven to various locations according to a prearranged schedule. On returning to home base, returned books and charge cards are unloaded and the vans are restocked for the next trip.

* * * * *

This is a general description of the kinds of work carried out in departmentalized libraries. Staff in smaller libraries perform similar functions, but with less specialization. There may be only a trained librarian doing the nonroutine and technical work, assisted by a number of library clerks having various amounts of education and training. Owing to a shortage of trained librarians, many small libraries employ people who have taken a short course in library work or who have some library experience.

The following section covers the fields of employment for librarians and library clerks, emphasizing the special kinds of opportunities for library services in each field.

FIELDS OF EMPLOYMENT

Public Libraries

There are some 1,050 public libraries located in communities throughout Canada, many of them having branch libraries. Full-time staff numbers 2,550. This figure, however, does not give a true picture of employment in the library field. Part-time workers are used extensively and some small libraries operate only on a part-time basis.

In large centres the character of public libraries is changing. The central library is becoming the seat of main collections, reference sources, special subjects, and technical services such as cataloguing, classifying and acquisitions. Branch libraries specialize

Provincial Library Services provide travelling libraries to isolated areas.

Photo: Ontario Department of Travel and Publicity

in circulation, catering to the reading needs of the community in which they are situated, such as family and children's reading, or books for foreign-speaking groups.

Regional libraries are operated in thirty-five centres in all provinces and the Yukon Territory. They are designed to centralize and strengthen, within a region, small community libraries which do not have adequate facilities. Located at a regional headquarters is a central collection of material with a staff to circulate it among libraries within the group. The librarian in charge may also help in planning exhibits of books and art, and organizing interest groups.

Provincial Library Services administer the provincial Library Act and in some cases supply books to sparsely settled areas within a province which would not otherwise have library service. Books and other material are selected by librarians, and are distributed by van, boat or rail to points where they are needed. Librarians may visit these areas from time to time to determine the needs and interests of the people living there. This, however, is the only direct contact such librarians have with their clientele.

The National Library

The National Library, not to be confused with the Library of Parliament (frontispiece), is charged with maintaining a union catalogue listing books in every important Canadian collection (at the end of 1960 the catalogue included 4,600,000 entries from 164 libraries). It publishes, monthly, a national bibliography of books, entitled *Canadiana,* and provides reference and research services for libraries across Canada.

Certain aspects of the work are quite different. Most libraries provide library services for readers; the National Library provides library services for other libraries. At present, librarians and staff have little or no contact with the public. In 1960, however, they received via mail or telephone some 11,500 requests from libraries and in about 90 per cent of the cases were able to locate the required publication and arrange a loan. Reference work, bibliography, cataloguing and classifying of material are important functions for these librarians. There is also a great deal of sorting and arranging material, typing and filing of cards, done by clerical staff.

College and University Libraries

It is impossible to imagine even the smallest university or college without a well-stocked, well-organized library. Books and learning go hand in hand.

University libraries are for study and research purposes; some may contain gift collections housed in separate rooms. When certain faculties in the university become large and important enough, they may establish a special collection of books in a faculty library which, in co-operation with the central collection, serves the specialized needs of students. Thus, one hears of a university's law library, medical library, or theology library. Library schools have their own libraries.

Over 1,200 full-time staff are employed in university and college libraries. There are openings for general and specialized librarians, particularly for those with knowledge in a specific subject area. The work consists in helping students and teaching staff engaged in studies and research.

Many graduates of library schools find the academic atmosphere to their liking, and choose university libraries as their field of work.

School Libraries

In 1960, some 1,500 elementary and secondary schools had at least one room set aside as a library, a collection of library material, and a person in charge all or part of the time.

Present-day emphasis on education is stimulating the growth of school libraries, and instruction in the use of libraries is being given as a school subject. There is a shortage of trained librarians for this field, although the shortage is overcome, to some extent, by *teacher-librarians*. Most provinces specify that they be qualified teachers. School librarians may direct reading programs, select and arrange material for school studies, give talks and tell stories to young children. In some cases a central library carries out technical and professional staff services, supplying new books from the central collection.

Special Libraries

Estimates of the number of special libraries in Canada vary, the number ranging between 320 and 350. They are set up and operated for the use of officers and members of various agencies and organizations, including government departments, professional and learned societies, industrial associations, business and financial firms, and newspapers.

Most of these libraries are, of course, highly specialized as to material collected, and may constitute the most comprehensive and authoritative source of information in a particular field. The library of the Department of Labour in Ottawa, for example, contains one of the country's largest collections of books, periodicals and documents on labour matters; the library of the Pulp and Paper Research Institute of Canada contains the basic collection relating to one of our most important industries.

Work in special libraries involves considerably more analysis, research and preparation of abstracts than is encountered in other libraries. Much of the material is unbound, and must be kept up to date to be useful. Newspapers require extensive libraries from

Photos: NFB

Special libraries usually contain highly technical material. A scientist in the federal Department of Agriculture checks the card catalogue for references pertaining to his research.

which to draw background material and pictures; radio and television broadcasting requires the same type of material as well as sound tapes and film; film libraries contain large collections of audio-visual material.

Within the special libraries field, about 200 are attached to federal and provincial government departments and give employment to some 700 men and women. Each province has a library for the use of legislators and to house provincial collections; the federal government has counterparts in the Library of Parliament and the National Library.

Photo: NFB

Government departments maintain extensive libraries.

Each government department has its own library designed and stocked to meet the needs of departmental workers, students and others interested in the field of departmental responsibility. Included are libraries for agriculture, science, labour, health and welfare, patents, and also collections in museums, art galleries and archives.

Special libraries attached to industry and business are increasing in number as management realizes the value, in terms of time and efficiency, of services rendered by a library and a good librarian.

Work in special libraries should appeal to those who have the necessary interest and training in a particular field, such as science, engineering, finance, art or politics. These libraries must stay in the forefront of developments in their particular field, making the work progressive and stimulating.

PERSONAL QUALITIES

Basic requirements for success and satisfaction in library service are an interest in literature, music, drama or art, an appreciation of the cultural values of society, and scholastic ability. Library service is sufficiently varied to appeal to people of differing temperaments. There is a place for those who like the detail and study necessary in cataloguing and research, or work in a particular field such as science and technology. Work with children, young adults, educators, the handicapped and infirm are challenging fields for those with the right interests and qualifications.

Library work offers career opportunities to both men and women, although women predominate in numbers.

Library staff must be reasonably strong and healthy. There is a great deal of walking back and forth in the library, climbing stairs, stooping to reach lower shelves, lifting and carrying books.

Library workers must be able to meet the public easily, especially when engaged in readers' services. They must be intelligent and resourceful to cope with inquiries and reading problems brought to them by people of varying tastes and backgrounds. A good appearance that comes from careful grooming, a pleasant attitude and quiet efficiency, are important in the library setting.

Ability to write for publication, to speak on a variety of topics before groups of people, and to give leadership in library programs, is essential for those wishing to advance in a library career. Artistic taste is also important.

Certain technical work, such as classifying and cataloguing, calls for people with patience and a capacity for meticulous, painstaking effort.

There is no longer a place for introverts or book-worms. Libraries are of growing importance to community life; the tempo of service is increasing; needs are expanding; and library personnel must be tuned to the changing character of community life about them.

Photo: NFB

Library activities are many and varied.

PREPARATION AND TRAINING

Library services tend to vary in quality according to the training, experience and background of the staff. Much routine library work is clerical in nature, requiring professional supervision but little specialized training. For library clerks, short training courses and some experience in library work may be sufficient. However, to be able to render a complete library service of high quality requires training at a professional level. Basic preparation should include a broad academic background acquired through university training, good reading habits, and an appreciation of books.

Professional Training

Librarianship is a graduate course based on matriculation from high school and a degree from a recognized university. The degree is usually a B.A. or a B.Sc., but with the growth of special libraries, certain other degrees are considered suitable depending on the content of the course.

Some universities stipulate that prospective students for librarianship make good marks in the last two years of the bachelor-degree course. While there is no set pattern, students should follow a broad general course including the humanities, social and physical sciences, and an additional language other than French or English (or both). Many scientific and political publications appearing in German, Russian, or Spanish, makes knowledge of a second or third language most useful. Students should have a good command of English language and literature—French if they are to attend the University of Montreal. Those who are interested in doing library work in a specialized field, such as art, political science, public administration, economics or education, may select optional subjects pertaining to their area of interest.

Some library experience is usually required, and many prospective students have worked as library clerks or pages. Some schools mention typing as a useful skill in carrying out class assignments.

Before students are accepted for studies in librarianship they are interviewed by the Director of the school or by someone appointed by the faculty to assess their personal suitability for the work.

Universities Offering Courses in Librarianship

Five schools offer postgraduate training leading to degrees in Library Science:

* *University of Toronto,*

B.L.S. after one year; M.L.S. after two years; (a limited number of qualified applicants permitted to take one-half of the course in each of two consecutive years);

* *McGill University, Montreal,*

B.L.S. after one year; M.L.S. after two years;

University of Ottawa,

B.L.S. after one year; M.L.S. after two years (lectures in French and English);

University of Montreal,

B.L.S. after one year; M.L.S. after two years (lectures in French only);

University of British Columbia, Vancouver,

B.L.S. after one year.

Prospective students are advised to consult school calendars for specific requirements for entrance, course content, fees and other necessary information. Arrangements for interviews and registration should be made early as enrolment may be limited.

Bachelor of Library Science

Assuming that students have already acquired the necessary background of knowledge in their undergraduate studies, library

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*These university courses meet required standards of training and facilities, and are accredited by the American Library Association Committee on Accreditation on behalf of the Canadian Library Association. Graduates of these schools may get preference, particularly when seeking employment in public libraries because these libraries receive additional grants when they have accredited graduates on staff.

schools concentrate on librarianship. This means training in the broad subject of bibliographical information and in the techniques and skills of professional library practice.

The course includes training in the principles followed in building a collection of books, periodicals and other material (selecting, ordering, maintaining and restoring); classification and cataloguing methods; use and sources of library materials; programming for various age and interest groups; organization and administration of library services in general and in the various types of libraries. Visiting lecturers and specialists in various fields contribute their practical experience.

Librarians learn by doing. Extensive practical work is done in the faculty and other university and outside libraries. Visits are made to publishing houses, various types of libraries and museums.

Master of Library Science

Four schools offering the M.L.S. degree stipulate a prerequisite of B.L.S. from the school or a school granting the equivalent degree. Generally, a reading knowledge of a modern language other than French or English is required, and sometimes two years experience in a library.

It is possible to acquire the M.L.S. degree through part-time study although, in some cases, full-time attendance for a specified period may be required.

Courses of an advanced nature are often directed to the type of work in which the librarian is engaged, e.g., cataloguing, documentation, administration, or research in a particular subject. A major research project may be required for the degree.

Tuition and Expenses

Tuition fees per annum vary from $276 to $425, including various student fees. Expenses for books, supplies and field trips may amount to $75. Living expenses are a major item when living away from home. Most schools have resident accommodation or can recommend suitable quarters.

Many students attending library school are doing so on a scholarship or some form of assistance. Library clerks who have

the basic requirements for librarianship are encouraged by their employers to study for a B.L.S. or M.L.S., often being given leave of absence or a grant to do so. Sometimes there is the provision that they return to work at the library for a specified period. There are also many other forms of student assistance about which you may learn by consulting your school principal or guidance teacher, from university calendars, or the Scholarship Committee of the Canadian Library Association.

Associations

Students are encouraged to take advantage of the facilities of various library associations and attend their meetings:

The Canadian Library Association
Provincial library associations and local chapters
Special Libraries Association (Montreal and Toronto)
Institute of Professional Librarians (Ontario)
Association Canadienne des Bibliothécaires de Langue Française.

Training for Library Clerks

No standard training for library clerks has, as yet, been set up. People with educational backgrounds ranging from some high school to bachelor degrees may obtain employment in libraries and learn the routine work while on the job. The level they start at and rise to may be dependent on the extent of education they bring to the position, the opportunities for in-service training, and personal suitability.

From time to time provincial authorities may arrange intensive courses lasting one or two weeks for in-service training of library clerks who have the responsibility of administering a small library. These courses consist of lectures and seminars on basic library practice, use of various office forms, discussion of problems, and opportunities to visit libraries and study their operation.

The Department of Education in New Brunswick offers a correspondence course in library work for people with high school matriculation and at least one year of library experience. It consists of reading and written assignments followed by an oral examination.

Photo: NFB

Library work is becoming more important in school programs.

Teacher-Librarians

The importance of library services in the educational system, and the establishment of libraries in most schools, is encouraging more and more qualified teachers to take the complete university course leading to the B.L.S. degree. Summer courses offering some training in librarianship are available for those who are doing full or part-time work in school libraries. The provincial Departments of Education will have up-to-date information of these summer courses.

ENTRY

Graduate librarians have at their disposal the usual placement facilities of all professional groups. Graduates are usually placed before graduation. A number return to their sponsoring library; some are placed through the university placement service.

Library periodicals carry notices of employment opportunities in their publications and officers of the organizations are in

positions to know of opportunities and to advise. Exchange positions in other countries often exist for those wishing to travel abroad for experience in foreign countries.

Library positions in the civil service are posted in public buildings. Information may be obtained by writing to the employing agencies of the provincial or federal governments.

Information about employment opportunities, both local and national, may be obtained from the National Employment Service, which has local offices in all important Canadian centres.

Employment in a library is dependent on one's education and training. Ontario and British Columbia have established a certification system based on qualifications. This determines librarians' levels of pay and government grants paid to libraries employing them. Graduates of accredited library schools have the highest certificate, followed by graduates of nonaccredited schools, librarians trained outside of Canada, library clerks holding a bachelor's degree, and others.

Librarians Trained Outside Canada

Librarians planning to work in Canada should make certain that their qualifications meet Canadian standards. Differences in academic requirements, in training methods used in other countries, and in language, may present employment difficulties.

Requests for information, accompanied by a complete outline of professional training and experience should be sent to the Canadian Library Association, 63 Sparks Street, Ottawa, or to the provincial association of the province to which you plan to immigrate.

An outline of *Requirements for the Practice of Librarianship in Canada* is available on request from the Department of Citizenship and Immigration, Ottawa, Canada.

ADVANCEMENT

Due to the shortage of professionally trained librarians, advancement has been rapid for qualified librarians willing and able to move to where opportunities exist. Graduates going to small libraries soon rise to responsible positions in that library, gaining early experience in library administration.

With experience, and sometimes additional training in a particular field, e.g., cataloguing or documentation, librarians may take charge of work in that department. Next steps in advancement are: librarian in charge of technical services or readers' services; librarian in charge of branch library; assistant to chief librarian; and chief librarian. These positions are usually held by people highly qualified through education, special training and long experience during which they have demonstrated personal suitability for responsible positions.

Librarianship is a field in which women are firmly entrenched and have good opportunity to rise to positions in administration and supervision. The percentage of men looking to library service as a career is small, but has increased over the last few years. Of the 1961 graduates in Library Science, more than one-third were men.

Library clerks may enter at lower levels and, with experience, may be reclassified to higher positions. In most cases, however, advancement is limited unless one is able to take professional training.

WORKING CONDITIONS

Working conditions in libraries are generally good. Undoubtedly there are still older buildings in use, with overcrowding in some cases, but efforts have been made to improve working conditions and to make libraries functional, attractive and comfortable. New library buildings, of course, include the latest ideas to make library practice attractive and efficient with, in some cases, new developments in automatic equipment.

Generally, library staff work a 30 to 40-hour, five-day week. Special libraries and most government libraries keep regular office hours; sometimes special arrangements are made to have someone on duty during lunchtime or after regular hours. Operation of school libraries is influenced by school hours and holidays.

University and public libraries must maintain service six or seven days per week, with closing times at 9 or 10 p.m., in which case some of the staff may rotate in shifts. This scheduling applies particularly to those engaged in readers' services. Overtime is necessary when there is a need to get special projects completed without interruption.

Photo: NFB

New library buildings are designed to make library practice attractive and efficient.

Earnings

In years past, earnings were low for all levels of library staff. Recently, however, substantial pay increases have brought earnings more in line with the training required and responsibility carried.

Many libraries have established salary scales for librarians and library clerks, with increases at regular intervals up to a maximum for each classification. Starting salaries are set, but new staff, with experience, may not be required to start at the beginning level.

Federal Civil Service salaries for 1962:

Librarian 1	$4,560	to	$5,160
Librarian 2	5,160	to	5,940
Librarian 3	5,640	to	6,540
Librarian 4	6,240	to	7,140
Librarian 5	7,140	to	8,220

Higher salaries exist for administrative posts.

Salaries for library staff in public libraries, schools, colleges and universities appear to be generally higher than those in most civil service positions. Pronounced salary differences exist depending on the size of the library and its geographical location.

Graduates of the 1961 classes in library science are reported to have started at salaries ranging from $4,600 to $5,000.

Less information is available on salaries for library clerks. Rates for library assistants (a title used for clerks holding a university degree in the federal Civil Service) for 1961, ranged from $3,900 to $4,500. Generally, earnings of clerks having high school education only are comparable to those paid office clerks in the community.

EMPLOYMENT OUTLOOK

There is little or no unemployment among qualified librarians. It is not an occupation that will lead to riches, but stability of library staffs provides a measure of security. Those who experience difficulty in being placed are usually people not free or willing to move about, or who are not completely conversant in English or French.

In point of fact, there is a great shortage of professionally trained personnel having the leadership and experience necessary to provide good library service. It is estimated that at present several hundred vacancies exist in Canada and more will develop when library services are extended.

Every phase of library service is undergoing an upsurge in activity. New specializations such as work with children, research,

art, music, and films, are coming into being to meet popular demand. New types of libraries are needed to deal with the increased volume of published material, and to make readily available the information it contains.

Supplies of new graduates in librarianship are not sufficient to meet present needs, let alone anticipated needs for the future. In 1960 there were only 112 graduates from all library schools; enrolments for 1961 are about 210. Based on the 1960 pattern, many of these graduates will return to former employers, leaving a small number to replace those who marry or retire, and to fill present openings and new ones being created. Part of the shortage has been relieved by librarians who have married and subsequently returned to work on a full-time or part-time basis after their families have grown up.

There appears to be no shortage of applicants for junior clerical positions in libraries, and competition is quite keen. The number of positions available is not expected to change greatly, other than through natural growth. As more qualified librarians are becoming available, there are fewer opportunities for nonprofessionnal staff to reach positions of responsibility.

Employment outlook for fully qualified librarians is, therefore, good. Several factors are operating that contribute to this favourable outlook. Library services are being extended in response to the needs of a growing population. More reading and study is being stimulated by the expansion of adult education, and the need for more education at all levels. As advancing science and technological development add to the complexity of the literature, need for special library services will increase.

FILMS

* *The Librarian* (1957), colour, 9 minutes

  Prepared for the Canadian Library Council as a recruitment film. Shows the ways in which a modern library serves the public and outlines the background and training needed to become a librarian.

* *Books in Hand,* colour, 20 minutes

  Illustrates the operation of the Sheffield (Eng.) Public Library, particularly the duties of workers in the various departments.

  Books for Beaver River (1961), black and white, 19 minutes

  Prepared by the National Film Board. It is the story of the Prince Albert (Sask.) Regional Library.

  Journey from Zero (1961), colour, 20 minutes

  Prepared by the National Film Board to show the distribution of books along the Alcan Highway.

* *Roads to Reading,* colour, 14 minutes

  Prepared by the Nova Scotia Travel Bureau to show the development of the regional library service in that province.

* *The Impressionable Years* (approx. 1955), black and white, 20 minutes

  Illustrates the work of the New York City Children's Library.

* *Beginnings,* black and white, 30 minutes

  Produced by Dr. Ralph Ulveling for the National Educational Television and Radio Center in New York City.

All films marked with * are available, on loan, from the Canadian Library Association, 63 Sparks Street, Ottawa, (rental $2 plus return transportation charges). Those produced by the National Film Board are available from the Regional Representative located in your provincial capital or from the head office, Box 6100, Montreal, Que.

LOCAL INFORMATION

CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices. Prices in Canada: $4.00 for colour; $2.00 for black and white.

Plumber, Pipefitter and Steamfitter

Careers in Engineering (revised in colour)

The Social Worker

Technical Occupations in Radio and Electronics

Bricklayer and Stone-Mason

Printing Trades

Careers in Natural Science (revised in colour)

Careers in Home Economics

Motor Vehicle Mechanic

Mining Occupations

Draughtsman

Careers in Construction

Machine Shop Occupations

Sheet-Metal Worker

Careers in Meteorology

Medical Laboratory Technologist (in colour)

Teacher (in colour)

Office Occupations (in colour)

CAREERS IN LIBRARY SERVICE

Monograph No. 47

TECHNICIANS IN SCIENCE AND ENGINEERING

Research
Inspection
Installation
Sales & Service
Production Planning
Design & Development
Teaching & Instruction
Operation & Maintenance

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THE QUEEN'S PRINTER

OTTAWA, CANADA

Canadian Occupations
Monograph 48

TECHNICIANS IN SCIENCE AND ENGINEERING

Prepared
by the
Economics and Research Branch
of the
Department of Labour, Canada

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ROGER DUHAMEL, F.R.S.C.
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OTTAWA, 1963

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FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada and from other quarters.

THE CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Technical and Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This booklet was prepared and written for the Manpower Resources Division by William Coe under the direction of William Allison, Head of the Occupational Analysis Section.

The branch is greatly indebted to the many organizations and companies whose assistance made this monograph possible.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

January 1963

Front Cover:

Defence Research Board technicians ready a prototype of Canada's "Topside Sounder" satellite for simulated space environmental tests. Lights provide heat to test the hundreds of black solar cells used to supply power

CONTENTS

TECHNICIANS IN SCIENCE AND ENGINEERING

HISTORY AND IMPORTANCE

Air-conditioned homes, television sets, electric stoves and washers, the man-made fibres in the clothes we wear—even the most casual glance around us will quickly indicate that we are living in an age of science and technology.

Scientists are reaching into the future to discover new laws and principles; engineers are applying those laws and principles to provide us with a myriad of goods and services which were unknown at the turn of the present century.

But as attention is drawn to the works of scientists and engineers, history often tends to overlook the vital contributions of other workers. Scientific discoveries and engineering achievements and, indeed, any project which will add to our material well-being, require the services of many people with varied backgrounds and with many different kinds of skill, knowledge and experience. This booklet is devoted to one particular group—THE SCIENTIFIC AND ENGINEERING TECHNICIANS—which has a major role in helping to translate scientific and technical ideas into usable products and services.

The term "technicians" may be new to you. They first appeared during the industrial revolution of the mid-18th century and, in 1833, the term reached the dictionary to define "a person skilled in the technicalities of some subject". But it was not until the present era of technological change that their importance has been recognized.

With its tremendous advances in scientific and technical knowledge, the 20th century has heralded a new way of life. This is the age of nuclear energy, of space travel and of mass-production and automation. These advances have caused significant changes in employment, particularly the emerging importance of technicians. Erection of a modern skyscraper, the development of a missile site, or the operations of an enterprise with an output of hundreds of products for thousands of customers, demand the services of specialists. These specialists include our modern technicians and they require not only practical skills but also a theoretical knowledge of their specialty.

On the Canadian scene, our rapid post-war industrialization has greatly changed the employment structure of the nation. In our factories, offices and in almost every section of our business and industry, many time-honoured skills are in less demand and a new group of occupations is arising.

So rapid has been the growth of this group of occupations that, at the present time, there is little uniformity in either job duties or titles. Depending on the industry, and often on the individual employer in that industry, they may be known by the work they do (inspector or material analyst) or by the equipment they use (geophysical computer or X-ray technician). In the province of Quebec, graduates of institutes of technology are known by provincial legislation as certified technicians and professional technologists. In many provinces, titles such as stationary engineer and aircraft maintenance engineer also have legal standing. While those who in industry are called technicians may be in duties ranging from little more than routine technical work to assignments akin to those of engineers and scientists.

At the present time the preparation of interprovincial titles, probably related to educational qualifications, is being investigated. However, until definite titles are forthcoming, there is no alternative but to use the term of convenience—technicians—in this booklet.

The technician occupations which will be described are similar in that certain sets of principles must be learned and a degree of skill acquired to apply those principles to actual situations; this knowledge is of a type which cannot be picked up in the course of a normal day's work. Therefore, *the term "technician" as used in this booklet applies to occupations which require a knowledge of physical sciences, engineering and mathematical subjects such as can be obtained by completion of a prescribed course of study at an institute of technology, or its equivalent in part-time studies.*

When reading the following pages, you should bear in mind that it is not possible to cover all aspects of this very wide group of occupations in this booklet. Should there be a technology on which you require further information, it is suggested that you read other booklets in this Series (listed on the inside cover). These give more detail on certain fields of work.

NATURE OF THE WORK

What do technicians do? Before the nature of the technician's work can be understood, it is first necessary to explain the "technical team", the team members and how they arrived in their different roles.

At the turn of the century, invention and production were separate realms each concerned with its own particular interests and problems. Science was the function of the universities; production and distribution were the province of the manufacturer; and inventors, it is said, lived solitary lives in garret or cellar workshops.

Today, this simple picture is no longer true. Because of technical changes—more complex goods, more complicated methods of manufacture, automation and mass production—the "team approach" has developed.

In one sense the whole operation of a company can be looked on as that of a single large team. Use of the term is however restricted to smaller units each containing specialists related to each other by the fact that they are working towards a common objective—research, design, production and so on.

Each team, approaching a problem from its own particular angle, consists broadly of three occupational groups: (1) the professions i.e., architects, engineers, scientists such as biologists, chemists, and similar workers; (2) technicians at varying levels of skill; and (3) craftsmen and other production workers. Each group, having travelled a different training path, is in a different though related role.

The university, traditionally, is the training ground for the professions whose role in formulating new ideas and organizing and directing the technical team requires a broad and deep theoretical knowledge of their chosen field.

Technicians, in contrast, require a more specialized kind of theoretical knowledge together with practical training in complex techniques for their role as link between the professions and production workers. Provincial institutes of technology provide a training route to technician careers. The institute programs are usually more completely technical in content than the university although both deal with the same general fields. In addition, training may also be specialized to suit the needs of industry in a particular geographical region, i.e., papermaking, textiles, mining, etc.

Craftsmen and production workers require manual skills to make the products and perform the desired services and are trained through apprenticeship and learnership. Apprenticeship consists of training on-the-job under the guidance of an experienced craftsman together with several weeks of full-time classroom study each year of apprenticeship. Learnership is similar but usually without benefit of formal classroom tuition.

The difference between theoretical knowledge taught in universities and in institutes of technology is significant in that this difference determines the respective roles of graduates. Through graduation from the institutes, technicians acquire sufficient theoretical knowledge plus practical skills for the job in hand without necessarily having complete mastery of that theory. For example, electronic technicians in the function of inspection have sufficient theoretical knowledge to interpret instrument readings and diagnose faults; they will not require the depth of knowledge to discover new electronic theories—this is considered the role of the scientist—nor to design a new broadcasting transmitter.

Thus by virtue of their training the main role of the technicians is to undertake some detailed aspects of the scientist's or engineer's work which would otherwise be done by them. In doing so, they are usually the link between professions and the production workers in the functions about to be described.

RESEARCH

Research teams require the support services of many technicians as well as co-operation between scientists such as metallurgists, and chemists, and engineers.

For technicians, a wide variety of duties is involved. At the highest level, a knowledge of complex techniques founded on an adequate theoretical knowledge is demanded. The range goes through many intermediate levels to that of routine tasks.

Typically, they assist scientists in programs of patient, carefully assessed experimentation. More particularly, they help design, make and operate special test equipment such as stress, motion, strain and other devices used in building, mechanical or aeronautical technologies. Others may use their mathematical and scientific training to assist in the analysis of experimental data.

Others such as laboratory technicians in physical science or biological laboratories prepare samples by marking, measuring and weighing or work with chemical scientists in qualitative and quantitative chemical analyses. The analyses of metals, viscosity of oils, structure of textile fibres and the composition of soils, are but a few of many examples. While laboratory aides undertake work which, although technical in nature, may be more routine and record results in the form of graphs and charts.

Most research is carried on in laboratories which vary greatly according to the industry and the importance attached in that industry to research functions. Some laboratories are clean, well-lighted buildings while others may be crowded with apparatus. Such dangers as may exist from handling chemicals, radioactive and similar materials are kept to a minimum by following tested and accepted procedures.

In addition to academic ability, research technicians require persistence and patience. Many thousands of experiments may be necessary before an end result is achieved, although no experiment is really wasted. To these qualities must be added those of resourcefulness and ingenuity—to make, and operate experimental equipment perhaps unlike anything built before.

DESIGN AND DEVELOPMENT

Design and development teams are concerned with the problems involved in the production of new tools, products and services, or in making improvements to those already in use.

Initial concept of a new product or service is the function of a designer who may be an architect, an engineer, a scientist or similar worker. Design functions delegated to technicians are usually limited to the many details which make up the final product.* With improvements to existing products, technicians undertake design following established techniques in the form of specifications, standards and similar technical data and prepare new designs in the light of established practices.

Draftsmen who predominate numerically in these teams produce drawings, assembly and installation instructions, and similar information from which production workers can make the products or perform the services. They require not only an adequate knowledge of drafting techniques but also thorough training in their particular technology. For example, electronic draftsmen require a knowledge of physics as related to the generation, propagation and amplification of electromagnetic waves.

Mechanical draftsmen make calculations not only in respect to the dimensions of an object but also of weight, strength and factors such as gear ratios. Therefore in drawing plans for machines and other mechanisms, they require a knowledge of physics, mathematics and the properties of metals.

Construction draftsmen must have a knowledge of building materials, theory of structures, contracts and specifications together with the mathematical training to undertake calculations associated with the design of steel and reinforced concrete structures.

** This limitation is particularly true in certain engineering fields. Where the term "design" is used in describing technicians' work in this booklet, it is intended to mean the functions given in these paragraphs and not those of design which, by provincial legislation, can only be undertaken by a member of a professional engineers' association.*

No matter how complicated the structure, or how simple the item, design and development starts here on the drawing board using the tools of science—geometry, trigonometry and calculus

Drafting, undertaken sitting at a table, is light work. It requires good eyesight and neat workmanship and the ability not only to visualize the item being drawn but also its relationship with other items in the final product.

Others in this team include development technicians who make working models, pilot plants and similar prototypes for testing purposes or to determine production methods. They are frequently highly skilled in the work of craftsmen, in machines and in industrial processes. Alternatively, they may be engaged in the reduction of test results into mathematical data.

Still other technicians are employed on liaison duties between the design offices and production departments; they examine any apparent drawing errors, may give concessions for alternative materials and processes and, in general, ensure smooth working between design and production teams.*

INSTALLATION

Enterprises such as telephone, electrical, air-conditioning, electronic computer and business machine companies, often install their own equipment in customers' premises. This is the work of teams of technicians and craftsmen although, on larger projects, the work may be supervised by an engineer. For technicians, this work involves a high degree of competence in craftsmen's skills.

They bring equipment into operation; ensure that it functions correctly; and diagnose and eliminate faults. After the equipment has been installed, technicians may be required to instruct customer employees in its use and, later, to make periodic maintenance visits.

Personal qualities include a neat appearance, clean work habits and the disposition to maintain friendly customer relations. They must be painstaking and pay great attention to detail so that the installations will operate with the minimum of inconvenience to the customer.

---

*For those interested in obtaining more detailed information, a booklet CAREERS IN DRAFTING is available in this Series.

Typical installation work—

Above:

Computer devices and data processing units are installed by business machine companies

Centre:

A central office switchman tests a new installation in Alberta Government Telephones

Below:

An 18,500 KVA generator is installed in a hydro-electric power station

OPERATION AND MAINTENANCE

Groups of technicians are employed in the operation and maintenance of enterprises such as telecommunications systems, radio and television stations, electrical utilities and oil refineries.

Their main task is to ensure that correct operating procedures are followed. This work often includes servicing and overhaul and bringing new installations into operation and sometimes offers opportunities for development, in thinking out improvements, or dealing with different circumstances and requirements.

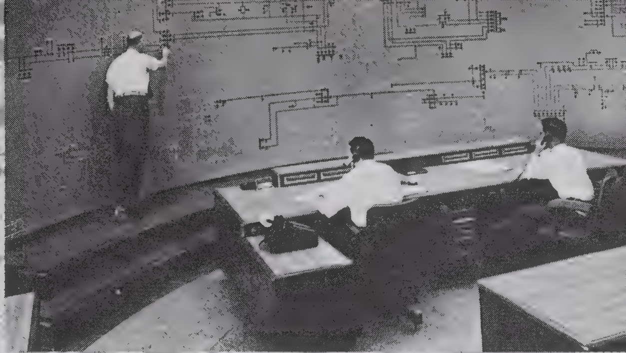
Other occupations include those of stationary engineers for which courses are available in institutes of technology. Provincial regulations require certification of engineers before they assume responsibility for power plant operation. They are in charge of and operate the steam-powered engines, compressors and other mechanical equipment in hospitals, office blocks and similar large public and commercial buildings, and in industrial enterprises such as thermal-electric, power-generating plants.

INSPECTION

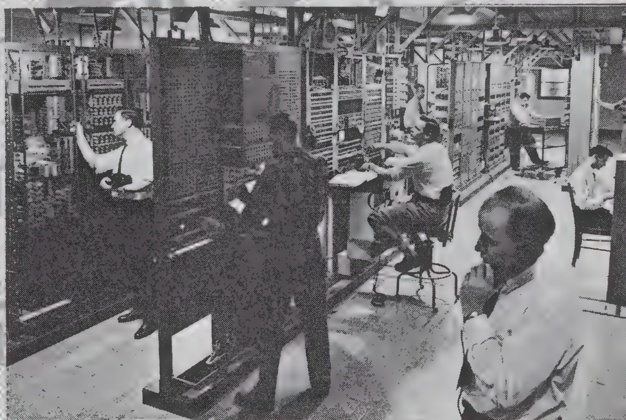
With the increasing complexity of many materials and processes, together with the demand for better goods and services, quality control has assumed great importance at all stages of manufacture and construction. It ranges from the examination of raw materials, through many intermediate stages, to the testing and functioning of the final product.

The work of inspection teams requires a variety of differing skills but may be considered in the broad terms of quality control, testing and inspection.

For those interested in obtaining more detailed information on plant operation, including power generation, telecommunications and broadcasting, a booklet ELECTRICAL AND ELECTRONIC OCCUPATIONS is available in this Series.



In electrical power stations, the output is regulated by the load dispatching group from the systems operating office



Teams of skilled technicians operate the electronic equipment at a main mid-Canada Line communications centre

In both radio and television broadcasting, technicians operate and maintain transmitting equipment

Quality control is usually the responsibility of the chemist, architect or engineer. Testing involves the use, by technicians, of electronic and similar measuring devices. Inspection in general is more routine and involves visual examinations or checks using mechanical tools such as micrometers, rules and gauges.

The kind of material to be tested and inspected depends on the industry in which they are undertaken. It may be the viscosity of oil; the strength and printing qualities of paper; the examination of a building for conformity to government regulations; or the checking of vehicles for safety.

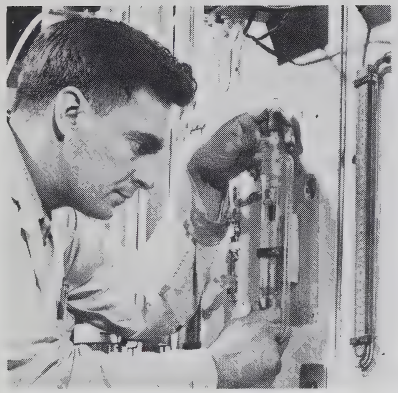
Quality control offices, view rooms and test laboratories are usually quiet, well-lighted buildings. In process inspection, technicians will meet the conditions prevailing in a particular industry. These could be the heat of a foundry, wet or cold weather of the construction industry or the jet engine noise associated with the aeronautical industry.

Confidence in their knowledge and judgment, and the ability to make sound decisions are important personal qualities. Integrity and a strong character combined with the ability to get along with others are needed when items have to be rejected for defects.

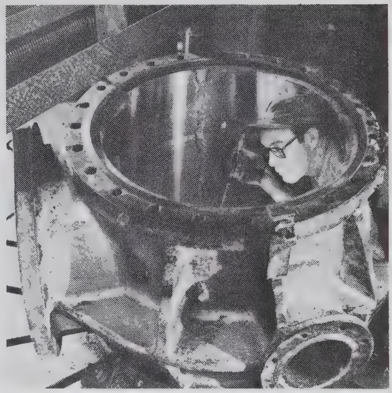
PRODUCTION PLANNING

Whether in the production of a single item such as a building, or the factory production of many similar items, planning is essential. It ensures the orderly arrangement of plant equipment, machine tools, purchase and supply of materials and the organization of production workers.

Ensuring that a project will move ahead according to a planned schedule is the function of production planning teams. The manufacturing industry employs many specialized technicians in this kind of work. In construction, stages of work are planned so that

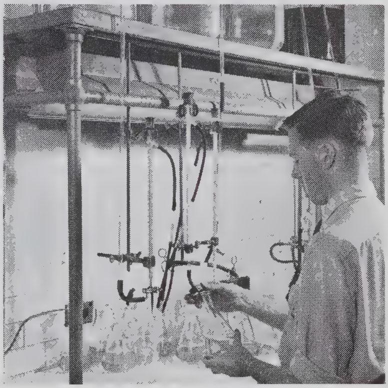


A process sample from an oil refinery unit is analyzed for quality

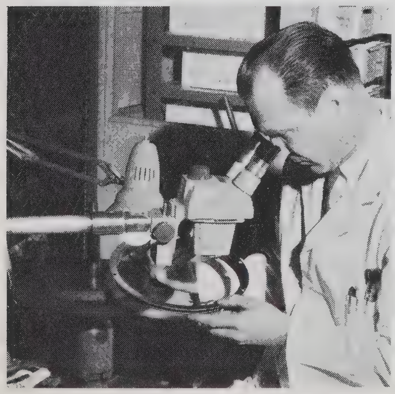


Inspection of a digestor valve used in the paper-making industry

Dimensional checks on jet engine turbine blades



Titration of a grain distillate to determine protein content



Investigation into cause of failure of a turbine engine air seal

Inspection is important in food processing

the most economical forces of men and machines are kept fully employed and materials are delivered when needed. Occupations for technicians include the following:

Production planners analyze design drawings to determine the necessary operations and the equipment, machine tools and kinds of production skills involved.

Tool designers and tool draftsmen in manufacturing plants design dies, fixtures and similar tools for production purposes. Such factors as material to be used, strength requirements, and tolerances and clearances are taken into account.

A further group of technicians, including *estimators* and *time-study planners,* ensure by careful analysis and planning of details that a project is scheduled through various operations in the correct and most economical sequence.

Procurement of raw materials and other supplies is the function of *purchasing agents, buyers, material planners* and their clerical assistants.

Production planning calls for a thorough mastery of production techniques. For this reason many technician positions are now held by highly skilled craftsmen. Many production problems need an understanding of time-and-motion measurement, statistical control and operations research and may also require knowledge of computing devices.

This work is undertaken in office surroundings although frequent visits to the various production departments, with their attendant noise, heat and similar conditions, are required.

Probably the most important personal qualities needed are accuracy, an inquiring mind, tact and the ability to work under pressure. Tact is necessary when standards for production workers and target dates for clients are set; technicians should always be investigating ways to improve production; ability to work effectively under pressure is necessary to avoid production delays.

TECHNICAL SALES AND SERVICE

There is a wide field of employment for sales representatives to inquire into the requirements of potential customers for technical equipment, consider the means by which these needs can be met, and supply technical data to their employers on which design and estimates can be based.

Technicians who enjoy meeting people and who possess sufficient technical knowledge to deal with the varied problems of their clients are being employed in increasing numbers. They must be competent to discuss operation, modification, repair and maintenance of equipment already installed as well as that they are seeking to supply.

Since sales personnel must be able to meet and get along with many kinds of people, certain traits of personality and appearance are necessary. In addition to technical ability, pleasant but forceful personalities who make a favourable impression in manner, speech and dress are the most likely to succeed.

Technical Publications

The preparation of technical publications is the responsibility of the technical publications supervisor, who is often attached to the Technical Sales and Service Department. He has a staff of technical writers and illustrators who compile and illustrate maintenance, operation, spare parts and instruction manuals. These are prepared from drawings, specifications and the writer's own knowledge of the operating principles of a company's products.

The ability to write clear, concise and accurate technical information is an important quality demanded of technical writers, as are the ability to discuss problems with all levels of workers, a good memory, initiative and resourcefulness.

Technical illustrators require sufficient creative ability to prepare perspective, dimetric and similar projections from engineering drawings. Accuracy and a knowledge of mathematics are essential as technical illustrations, unlike those of the "fine arts" field, must be drawn exactly to scale. A knowledge of printing and other reproduction processes is also an asset.

TEACHING AND INSTRUCTION

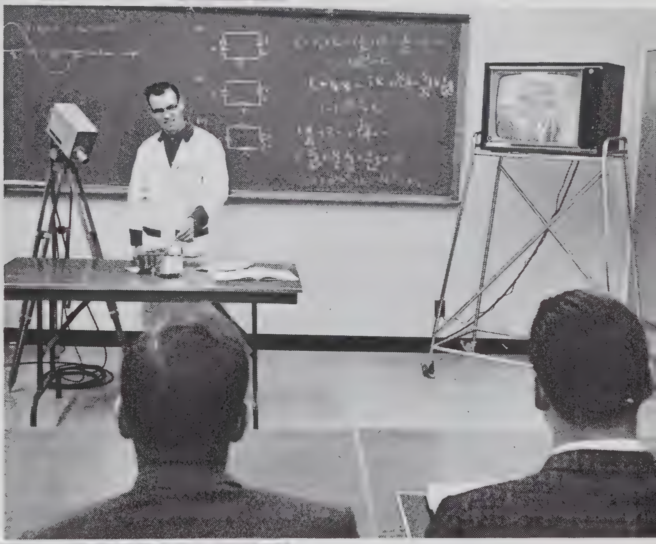
In industry, techniques often change as new products or improvements to existing ones are introduced. These changes may necessitate the retraining of employees. The teaching of these further skills is often delegated to technicians who may be employed as instructors either on a part-time or a full-time basis. This instruction varies considerably, ranging from instruction periods in company workshops to full-time tuition in well equipped classrooms with every modern convenience.

Teachers in trade and vocational schools require an extensive knowledge and skills in the trade being taught in addition to the necessary background in academic subjects. For this reason, teaching positions are often filled by technicians and craftsmen who have transferred from industry. Those employed in publicly operated schools must hold a teaching certificate which can be obtained by attendance at summer schools, or through full-time day courses of six to ten months' duration.

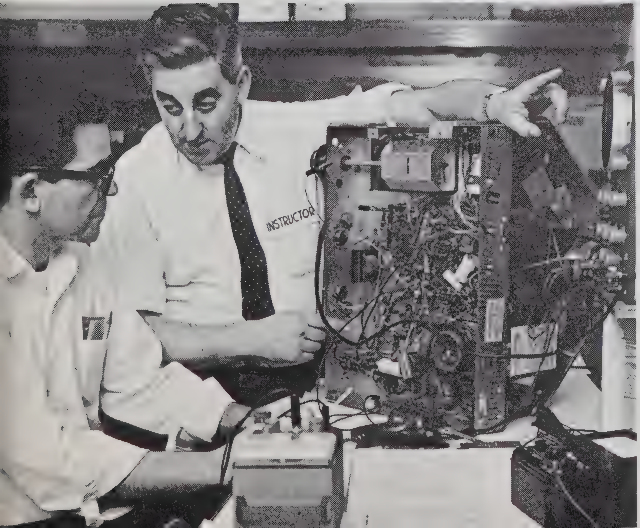
In addition to having the skills being taught, teachers and instructors must have a sincere desire to help people and the ability to impart their knowledge to others. Leadership—that indefinable quality which commands respect—is essential for the maintenance of classroom discipline. Other desirable qualities include a good appearance and a clear speaking voice.

For those interested in obtaining further information on teaching careers, the booklet TEACHER is available in this Series.

Students are taught machine shop practices in Vocational Schools



Many Canadian companies employ instructors in plant training programs



Instructors explain the practical application of theoretical studies in this provincial Institute of Trades

FIELDS OF WORK

Where do technicians work? Wherever there are scientific and technical activities technicians are there also, working in some important capacity. In fact, technicians are now so widely employed that it is possible only to include some of the many fields of work in a booklet of this size. Fields of work selected for inclusion are those for which courses are currently available in institutes of technology, or for which there are other clearly defined training routes.

ELECTRICAL TECHNOLOGY

Two main fields of employment are provided by electrical technology—power and electronics—but, within these fields, there are many divisions. For example, an electronic technician may work in one division, perhaps communications, but will specialize in a subdivision such as television or telephony.

Technicians in any division will find themselves using their theoretical training and practical skills in one or more functions described under *Nature of the Work*. However, their precise function will be governed by the division in which they may specialize, details of which follow.

In power generating stations and substations, technicians are assigned such duties as operation and load planning. Or they may test, inspect and maintain generators, motors, transformers, automatic controls and similar equipment.

In electrical manufacturing, technicians assist in the design and testing of electrical products which may range from massive power-station generators to small appliances for domestic households. They help solve problems connected with their company's products such as improving performance or size reduction; they supervise production processes and undertake non-routine testing and inspection.

In factories, hospitals, hotels and other large buildings, they supervise the installation of electrical systems; inspect these installations for conformity with local and federal Electrical Codes; and may undertake maintenance and repair work. Yet others are employed in such specialities as ultrasonics—a simple application of which is the cleaning of instruments—high-frequency heating, or the diathermy and X-ray apparatus of the medical field.

The broad field of electronics can be considered as that branch of electricity which makes use of components such as tubes and semi-conductors (transistors). In its more familiar uses, electronics is the basis for radio, television and other forms of communication. Other applications include those of industry, commerce and defence.

There are many areas of employment: equipment manufacturing; recording, measuring, controlling and indicating industrial processes; military and civil guidance and navigational systems and the many varieties of telecommunication. The recording of messages, statistics and inventories is becoming dependent on computing devices which, together with automatic controls (automation), are dependent on the electronic tube or semi-conductor. Not to be overlooked is the importance of electronics in other fields: the electronic cardioscope and microscope of medicine and science; the cyclotron and betatron of the atomic energy field; and the electronic telescope of astronomy.

The manufacturing industries undoubtedly offer the greatest number of employment opportunities in one of the major divisions: military and civil equipment; consumer products; electronic tubes and semi-conductors; and miscellaneous equipment.

Military and civil equipment manufacture includes instruments and equipment for guidance and detection systems, automatic controls and computing devices. Government departments make extensive use of this equipment; for example, electronic technicians are employed by the Department of National Defence in the maintenance and operation of the Distant Early Warning (D.E.W.) Line; by the Department of Transport to service and operate telecommunications systems and navigational systems such as radar, Loran and Instrument Landing (I.L.S.) for aircraft or shipping; and in many functions by the Armed Forces.

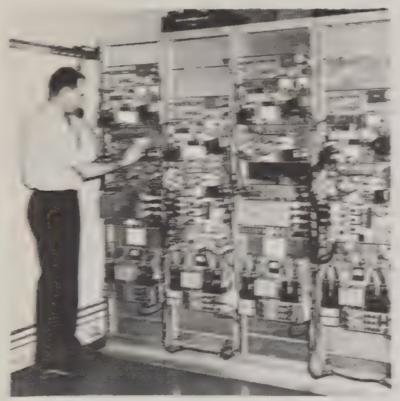
Consumer products include television, radio and high fidelity equipment and such appliances as hearing aids. Technicians are engaged in development, testing, supervision of manufacture and participate in the design of these products. Other major activities include the many functions required in the design and manufacture of tubes ranging from the radio receiving tube to those required for special purposes—the klystrons, magnetrons and cathode-ray tubes.

Modern industrial enterprises such as oil refineries, chemical plants, steel mills and paper mills have instrumentation installations, usually involving electronics for measurement, indication and control of various processes.

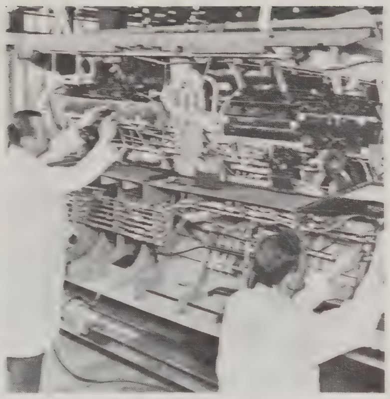
Many different combinations of theoretical knowledge and practical skills are required because of the wide variety of duties involved. Those engaged in assessing test requirements, planning test procedures and designing test apparatus require a high standard of knowledge in electrical and electronic theory. Testing and inspection work relies more heavily on practical skills in the use of such instruments as oscilloscopes, signal generators, ohmmeters, a.c. and d.c. bridges and high-voltage tests sets; sufficient theoretical knowledge is required to interpret, analyze and calculate test-set readings and recordings. Workers in repair and maintenance who are called technicians use handtools such as screwdrivers, wrenches, pliers and soldering irons and, as a general rule, use little mathematical and theoretical knowledge.

There are, however, certain characteristics all technicians must possess that are of vital importance in electrical power and electronics. These are a definite liking for study and a genuine interest in the field. Electrical technology is the most rapidly changing of all technologies. Most of the significant developments have been made within the past twenty years; the next ten years will see developments unforeseen at present. This means that technicians must be prepared to study and keep abreast of all the latest developments.

For those interested in obtaining more information on power generation, telecommunications and broadcasting, there is a booklet ELECTRICAL AND ELECTRONIC OCCUPATIONS in this Series.



Microwave equipment under test

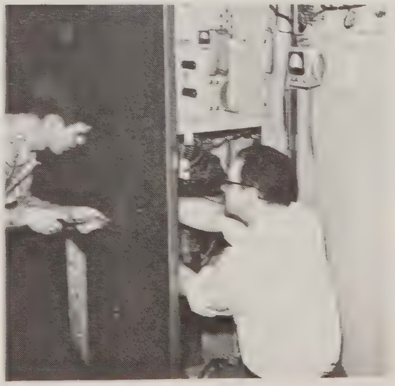


Installation of aircraft electrical systems

Design drafting is an important function

Military equipment must meet rigid standards

Diagnosing faults is another function of technicians



Assembly of television transmitter presents no problem to the well-trained technician

MECHANICAL TECHNOLOGY

Since virtually all industries use machines, mechanical technology underlies many different industrial operations and merges at some point with many other technologies. For example, mechanical technology provides mechanisms and equipment for electrical and civil engineering projects.

There are several main areas of specialization, the scope of each being so wide that technicians will specialize in one of the following sub-divisions.

Power-generating machines—steam, diesel and other internal combustion, tidal and wind power machines; hydraulic and gas turbines.

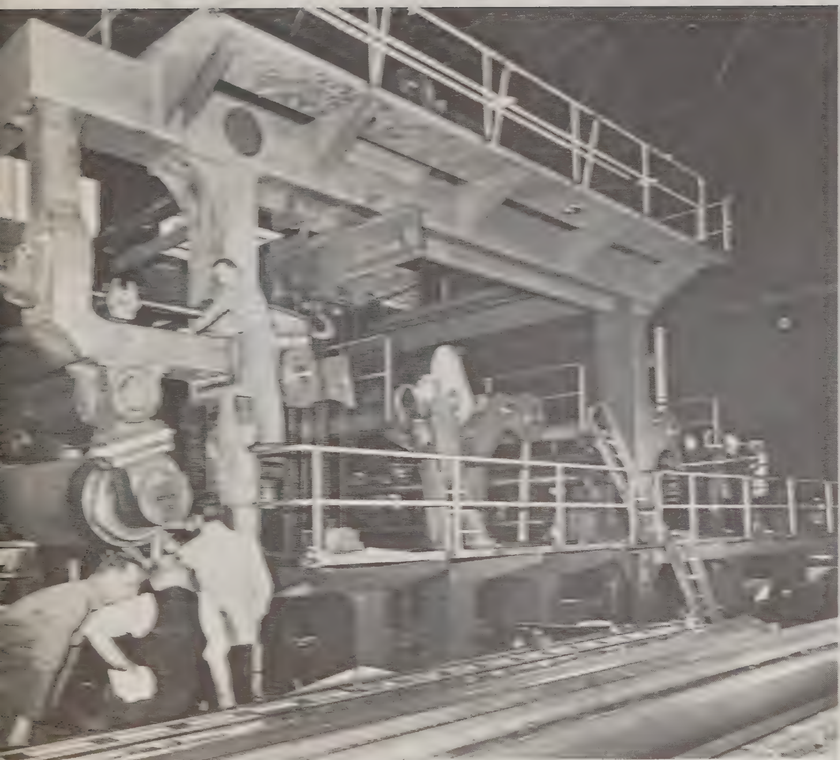
Power-transmission and material-handling equipment—conveyors, gears, shafting and heat transfer.

Power-using motors and bodies—machine tools, fans and other appliances; industrial furnaces; automobiles, locomotives, aircraft and marine vessels.

Air-conditioning—heating, ventilation and refrigeration.

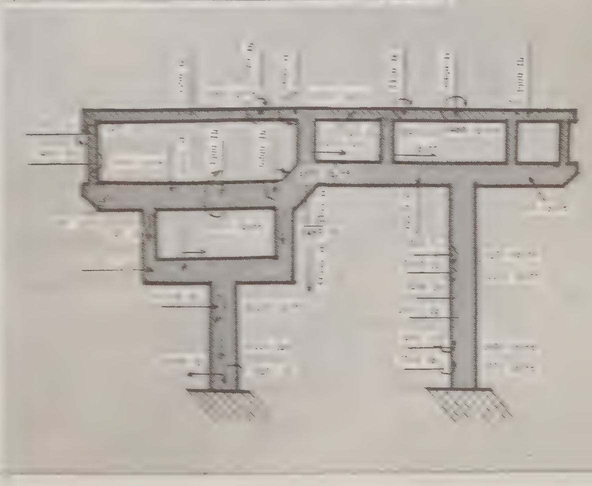
Technicians whose talents lie more in mechanical ingenuity and organizing ability are to be found as superintendents, installation foremen, production planners and detail analysts. Those with drafting ability translate design ideas into working drawings. Those with mathematical and scientific ability may be involved with technical problems related to gearing, lubrication, bearings, shapes and structures. Yet others are in maintenance, inspection and operation.

In addition to academic qualifications, the aspiring technician requires an inquisitive mind, not only to find out how a mechanism works but how to make it work better. Manual dexterity and the initiative to cope with unanticipated situations when they arise are decided advantages.



Typical of the many different functions in which technicians may be engaged is installation work such as the erection of the press frame shown above

Design of this press frame involved a number of rigid joints (depicted on the right). To match them all, a system of more than 100 mathematical equations had to be solved



AERONAUTICAL TECHNOLOGY

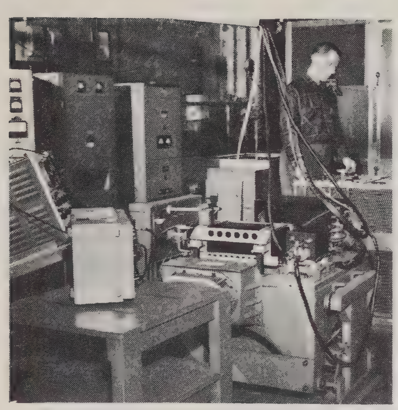
Well over two hundred different kinds of technicians are employed in the aeronautical field. A wide variety of duties is involved and it is possible to give only general outlines. There is a booklet, OCCUPATIONS IN THE AIRCRAFT MANUFACTURING INDUSTRY, which forms part of this Series.

Broad fields of work for technicians include research, design and development departments, manufacturing functions and airline operation.

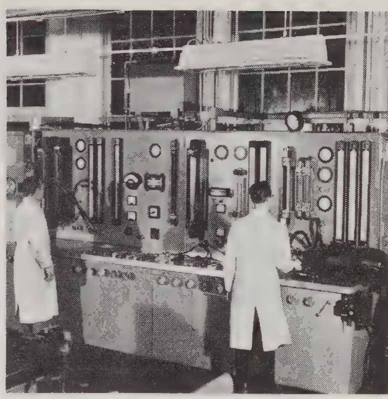
Research and development technicians are employed in the search for new materials, ways of improving speeds and payloads. Their work includes flight test evaluation, weight control and stress analyses. It also includes wind tunnel investigations into airflow around shapes, structural and vibration testing and the performance testing of engines and their components. Research work is being carried out in the field of space vehicles such as the *Black Brant* high-altitude research rocket and the *Alouette* satellite where technicians are assisting in experimentation and development.

Design and development technicians work in experimental departments, laboratories and design offices which are clean and well lighted. Noise is to be expected in wind tunnel work and in engine testing. Some technicians work at drawing boards and perform very few physical tasks: others, in engine test cells or in flight test programs, live very strenuous lives.

Manufacturing consists of many branches—engines, airframes, installation of equipment and systems, inspection and so on. Technicians assist with the application of engineering principles in solving design, development and modification problems. They prepare preliminary sketches and working drawings; act as liaison between engineering and production departments; and undertake quality control, production planning and tool design.

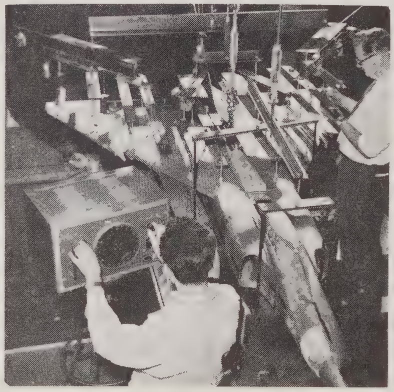


Functions carried out by technicians include environmental testing—freezing, heating, altitude, vibration, etc.



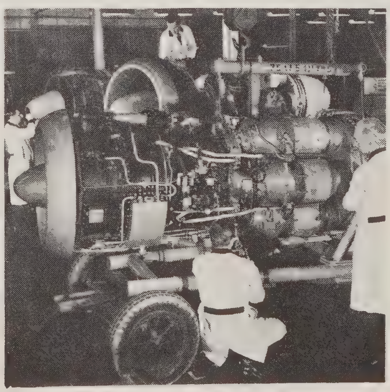
Types of equipment used in testing are depicted to the left and above

Space vehicles are assembled and tested by technicians



Flight models are stressed using strain gauges and similar devices

Components such as this heater valve actuator examined for defects



Jet engines are periodically serviced by technicians

Air transportation technicians are more concerned with the practical aspects of aircraft maintenance and with the operation of airport facilities such as direction-finding, landing and communications systems.

In maintenance work, technicians may be exposed to inclement weather and, since air transportation is on a round-the-clock basis, shifts and week-end work are to be expected.

Civil airlines operate under federal government regulations which require that those responsible for aircraft maintenance have special qualifications. Training for these qualifications can be obtained in institutes of technology. For example, a diploma from the Department of Aeronautical Technology, Southern Alberta Institute of Technology, is recognized as an exemption from most of the Department of Transport examinations for Aircraft Maintenance Engineers' Licences.

Aircraft maintenance engineers may be in positions ranging from superintendent to that of mechanic in the rebuilding, repair, overhaul and quality control departments of aircraft companies.

Most aircraft plants, hangars and laboratories are modern, clean, and well lighted buildings. Equipment, tools and materials are of the latest design as can be expected in a newer industry.

INSTRUMENTATION TECHNOLOGY

Technological changes in industry and business have led to the replacement of human judgment by automatic control. Continuous production methods, greater accuracy and reduced margins of error have become possible, due to the development of instruments which measure, indicate and control.

Types of instruments now in use are many and varied, embodying as they do electrical, mechanical, hydraulic, pneumatic and perhaps optical principles. Because of these many principles and the increasing complexity of industrial processes, instrument technicians require a thorough knowledge of mathematics, physics and sciences in many phases of instrumentation in addition to the techniques of instrument repair.

There are two main fields of employment. One is with firms who design, manufacture and sell engineering, laboratory, scientific and optical instruments; the other is in industries such as the chemical, petroleum refining, papermaking, electrical utility and the air transport fields. Smaller numbers of technicians are in meteorology, geophysics and similar scientific fields.

Occupations in instrumentation are still emerging and there is considerable overlap between instrumentation, mechanical, chemical and electrical technicians. Consequently, duties will vary from industry to industry, and from company to company within the same industry. In general, technicians develop, install, calibrate, trouble-shoot and repair instruments and control systems.

Routine functions, which can be undertaken without going into a theoretical analysis in each case, such as bench repair and servicing, are carried out by apprenticeship-trained technicians or mechanics. Graduates of institutes of technology are more likely to be employed in functions demanding theoretical knowledge. These could be the design functions of an instrument manufactur-

ing company, i.e., the mocking up and testing of new systems; preparation of circuit diagrams and component selection; layout of systems for a new industrial process; or obtaining and interpreting engineering and scientific data.

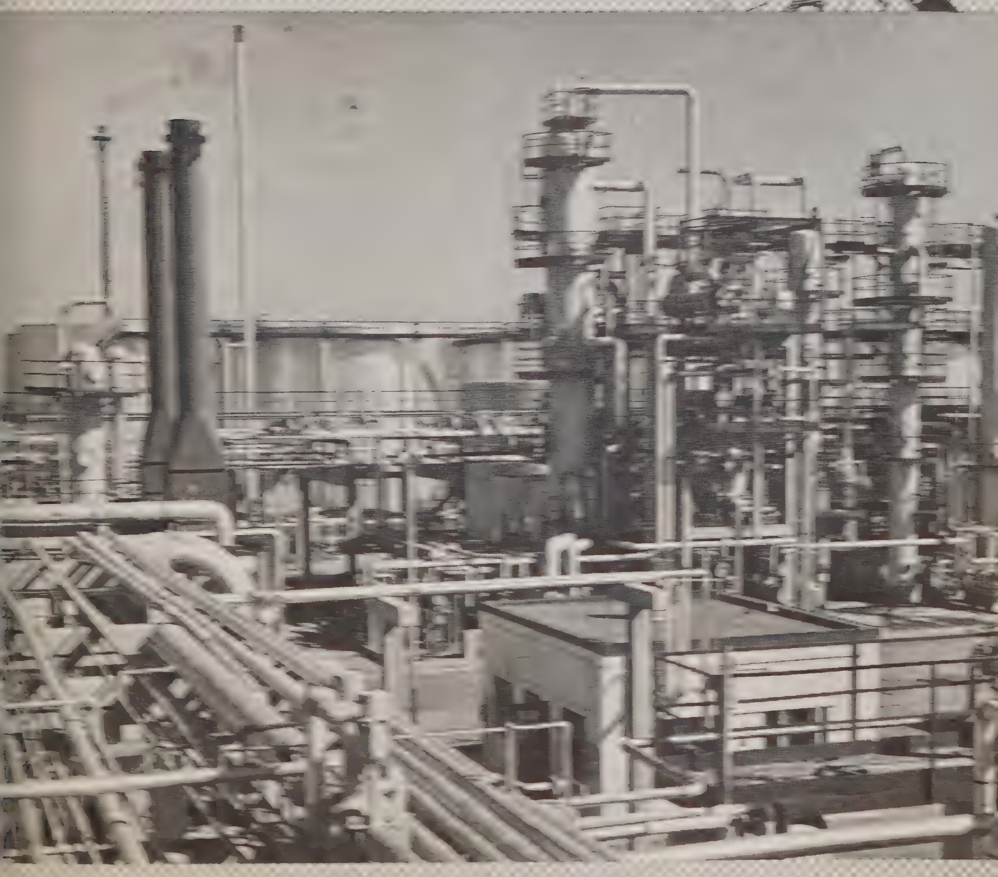
Alternatively, in industry, technicians may develop and install the instrumentation necessary to control a particular industrial process. To control a process, variables such as temperatures, densities, liquid flow and levels, pressures and relative humidities, have to be measured. Technicians, in conjunction with control engineers, prepare design drawings showing the most suitable components and systems. Then, primary elements are installed by tradesmen. Transmission lines—electrical, air, liquid and vacuum—are installed by technicians, coupled to controllers and tested for leaks and other defects. Scales and recording charts of the controllers are calibrated and, finally, the whole installation tested for correct operation.

The foregoing will indicate some of the many tasks of the instrument technicians. Their duties are changing rapidly, new problems are always arising and instrumentation is being applied to many new industrial processes. For these reasons, technicians must be alert to notice small details and must be able to grasp oral instructions easily and quickly.

Instrument technicians will meet a variety of working conditions. Those with instrument companies spend their time in the cleanliness and orderliness of engineering offices. Those working, for example, on pipeline instrumentation may be in isolated surroundings. Those in process control will have to work in plants and meet existing conditions of heat, dirt, dust and noise.

The Control Room of the Imperial Oil Refinery at Edmonton, Alberta where operators, through the use of instrumentation, control all refining units, indicator flow recorders, temperature gauges and pressure gauges

Information is provided to the operators by panoramic panels with diagrams



CHEMICAL TECHNOLOGY

Chemical technology is the application of laboratory processes to large-scale commercial manufacture and includes the design, construction and operation of plant and equipment. The use of chemical technology is widespread and continues to grow; for example, during the period 1958-60, investment capital in the Canadian chemical industry increased at a rate three times that of other manufacturing industries.

Technicians are employed in industries such as petroleum and its by-products, synthetic textiles, protective coatings, plastics, pharmaceuticals, insecticides, food processing, metals and minerals.

Functions of these technicians vary from research, development, plant operation and quality control to sales and service. More particularly, technicians undertake the following duties:

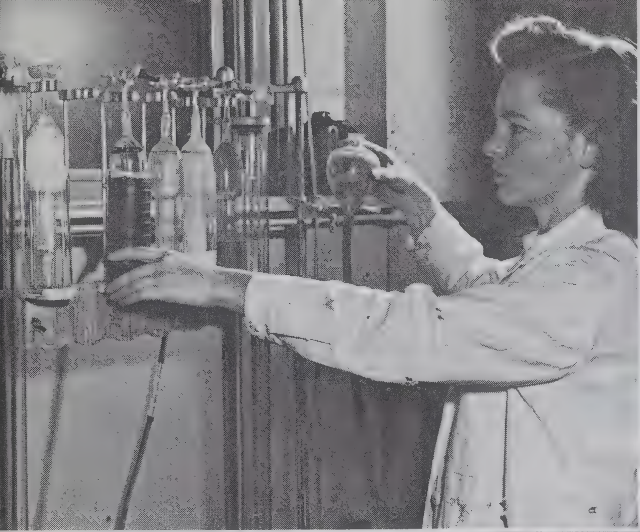
In research and industrial laboratories, they assemble and operate experimental equipment; use mathematical and chemical data to make calculations and measurements; and perform qualitative and quantitative analyses.

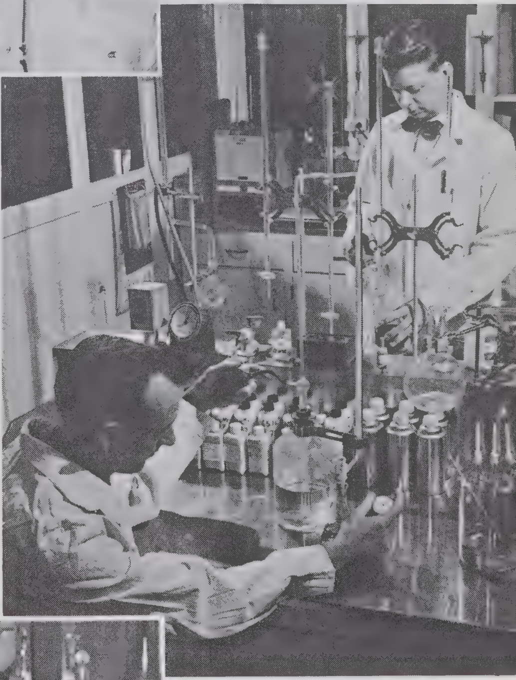
In process development, technicians may build small-scale plants to test a design before full-scale production is authorized. Where batches of different chemicals are made, they may work on new formulae and processes before they are put into production. Others perform quality control tests ranging from routine sampling to complex analyses.

In plant supervision, technicians are increasingly employed where a high degree of automatic control is being introduced.

Probably the most important personal qualities are those of mental curiosity and perseverance; for many laboratory operations, a liking for precise detail, and good eyesight is essential.

The conditions encountered in laboratories include fumes and odours although any danger is removed by adequate ventilation. Process and plant supervisors will be called on to work in an environment where conditions of heat, fumes and dust may be encountered.





Chemistry underlies many industrial processes—virtually every industry employs chemical technicians

Above: An Orsat gas analysis apparatus used in the synthetic rubber industry

Centre: Cosmeticians experiment with hand lotions

Below: Research laboratory scene in a metallurgical laboratory

ARCHITECTURAL TECHNOLOGY

The rapid expansion which has taken place since World War II in the construction industry has led to the growth of many jobs for technicians. Architects, faced with the design of large buildings employ technicians in many functions which they would otherwise perform themselves.

In this technician group, the work depends on the activities carried out by the employer. Typical functions are given in the following paragraphs but often several of these are combined, depending on the size of the architect's business.

Architectural draftsmen prepare presentation drawings and scale models under the supervision of an architect. When the preliminary schemes are approved by the client, technicians incorporate any desired modifications and prepare actual working and detailed drawings to be used on the building site.

Drawings are sent out to contractors with invitations to tender and are supplemented by instructions written by specification writers. In the contractor's offices, estimators prepare cost analyses and quotations for submission to the clients.

At the final stage, that of construction, technicians work on the building site as clerks-of-works, foremen, inspectors, supervisors and material planners.

Employment is found with architectural offices and consulting engineers; in similar positions with the architectural departments of federal, provincial and municipal governments; with real estate, building contracting, commercial and industrial concerns; and with town planning, landscape and similar consultants.

Architecture is the fine art of creating buildings of beauty and, for this reason, architects and their assistants must have an interest in the arts and a marked talent for drawing. They need a creative and original turn of mind, imagination and the power of visualization. To these must be added a practical outlook; decisions as to

which methods and materials to use within certain cost limitations, demand a practical as well as an artistic frame of mind. Since the architect's success depends, not only on ability, but also on personal service, technicians with pleasant, tactful and forceful personalities can add a great deal to this success.

Architects' offices, designed not only as working areas but also for the reception of clients, are clean, well lighted and usually air-conditioned buildings. Technicians employed on building sites will encounter seasonal weather conditions and reasonably good health is necessary.

CIVIL TECHNOLOGY

Design and construction of stationary structures, planning and zoning, and the surveying and reconstruction of geographical features of the earth, is a simple definition of civil technology. For technicians this is a very broad field of work and overlaps with many other technologies. Civil technicians, for example, work with electrical technicians in the construction of electrical power generating stations or with chemical technicians in the laying of gas and oil pipeline systems.

Within civil technology, there are four main fields of work, each with many subdivisions:

Transportation—highways, streets, railroads, viaducts, airports, bridges, tunnels and subways.

Structural—bridges, tunnels, subways, large buildings and electrical transmission towers.

Hydraulic—dams, flood control, irrigation systems, harbours, canals and tunnels.

Sanitary—reservoirs, drainage and sewage disposal systems, and pollution control.

Typical technician functions in these subdivisions include the following:

Assisting city engineers in the design and layout of streets, sewers, water mains and other facilities; or in planning, zoning and traffic studies necessary for efficient city maintenance.

Drafting detailed drawings and plans for structural steel and reinforced buildings, roads, bridges and other rights-of-way.

Estimating amounts and costs of materials, supplies and labour for construction projects.

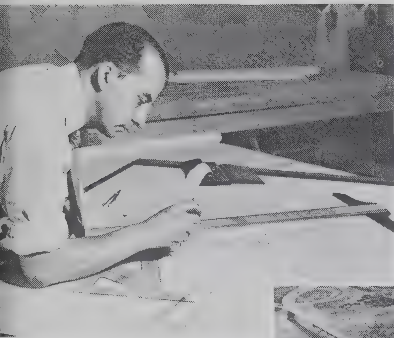
Supervising construction projects; inpecting grades, forms, materials and construction methods.

Determining co-ordinates for geographical positions, land lines and land monuments (under the direction of a licenced land surveyor).

Surveying—the establishment of elevation and positions for road and engineering construction—is a separate and distinct field of work although practised as an important part of civil technology. Institute of technology courses are available in surveying with a stated two-fold purpose: to provide the practical skills and knowledge of surveying to earn a living directly on entering this field; and to prepare students for the professional examinations of the Dominion or Provincial Land Surveyors' Associations.

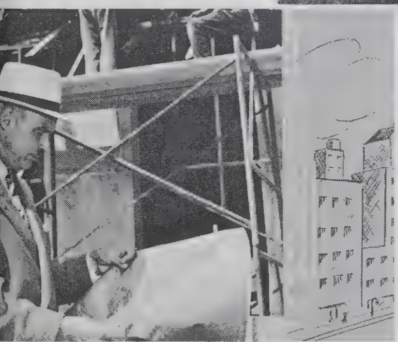
In addition to surveying opportunities in civil technology, there are also opportunities with oil and gas companies, consulting engineers and provincial or federal government departments, such as the surveying and mapping branches.

Many civil technicians are employed in outdoor duties, and possibly in isolated and rugged districts. In consequence, a good physique is necessary to cope with adverse weather conditions. Civil technicians should be inquisitive, have analytical ability and interest in detail, since many positions require such qualities. Although they are expected to follow directions accurately, they should have sufficient initiative to meet difficult and unexpected situations which will arise from time to time.



Above: Topographical drafting

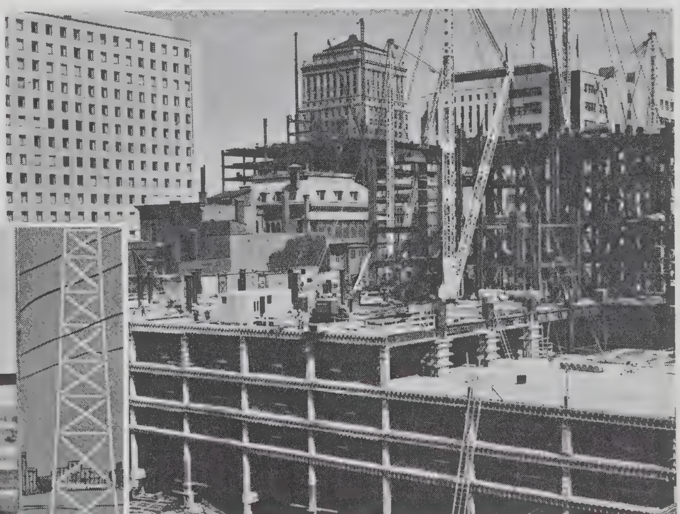
Upper right: Surveying



Typical technician functions in civil technology include the following. There are many other supporting but equally important functions

Above: Clerk-of-Works

Below: Supervisor and foreman



AGRICULTURE

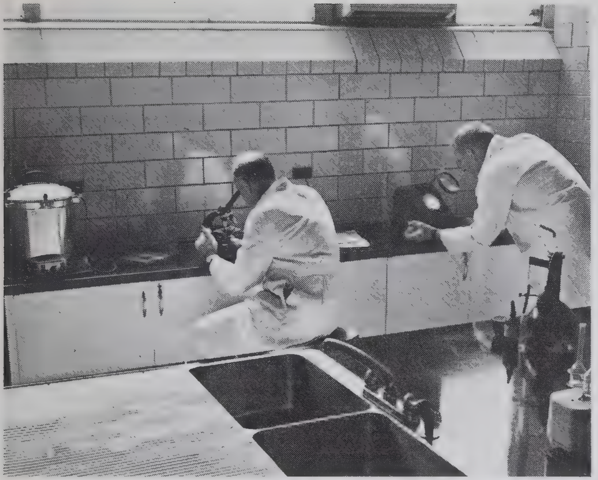
A century ago, farms were largely self-supporting and independent of other segments of the community. Today, the situation is very different; the farmer, generally, is dependent on other technologies for machinery, chemicals, ready-mix feeds and on utilities such as electric power.

Many other changes are taking place. Farms are greater in size or intensity, more specialized, and require more capital for their operation. Canada is one of the world's largest exporters of food products, but this market is increasingly competitive. To meet this challenge, and that of feeding a growing population, farming has become a complex industry whose future will depend on the success with which advances in biology, chemistry, engineering, physics or economics can be incorporated into farming to increase productivity and thus reduce costs.

In the face of these changes, a realignment is taking place in agriculture and fewer but more highly skilled workers are now employed. The need is also being felt for specialists in one or more branches of agricultural technology—an intermediate person between the professional agrologist and the agricultural worker—and who may be considered as the agricultural technician.

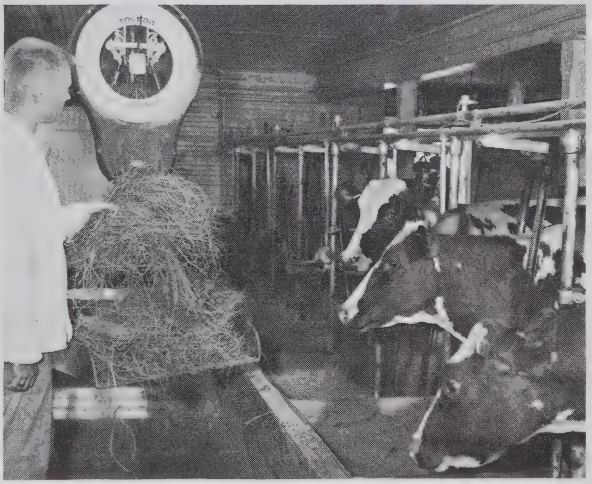
At the present time, most of the tasks which come within the scope of the technician have been assumed by the agrologist. However, technicians are employed as research assistants and laboratory aides, primarily in government departments. Others undertake performance tests, grading and inspection duties and act as grain buyers or information officers.

Diploma courses in agriculture, usually of two years' duration, are currently available in eight provinces. Active steps are now being taken to provide training of a more highly specialized nature. Significant is the recent setting up at Ste. Anne de la Pocatière of post-secondary school courses the graduates of which will be awarded a diploma in technical studies in agriculture. This diploma will probably provide the entrance requirement to membership of the Corporation of Professional Technicians of the Province of Quebec.



Twenty years ago, an agricultural worker supplied enough food for himself and nine other persons. Today he produces enough for 22 other persons. This increased output is the result of skills, knowledge and resourcefulness of many workers including technicians. Here are a few examples of the technician's contributions

Technicians work in basic research



They undertake nutritional tests to develop better feeding practices and better quality feeds

And apply their engineering and technical knowledge to the development of mechanized equipment

It is expected that when more specialized training becomes available, technicians will staff public and private farm services and fill many positions in business and industry serving agriculture. Knowing the most efficient engineering techniques they could advise on the best use of power equipment; knowing the chemistry of soils, fertilizers and insecticides they could advise on their use; and could advise on new plants and animals or the latest methods of grading and packaging.

FOOD PROCESSING

The technology of food processing, simply defined, can be considered as the industrial preparation and preservation of edible products.

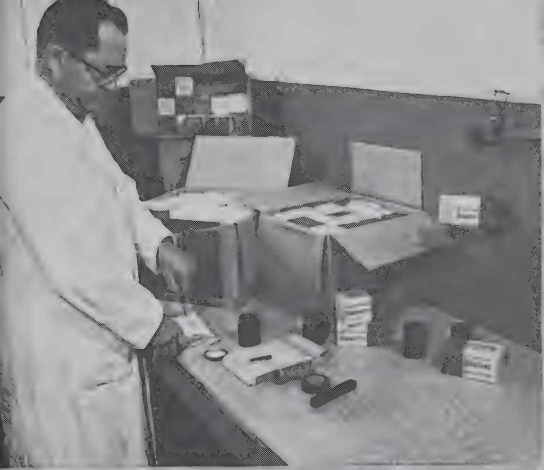
Methods of preparation include such processes as drying, salting, cooling, heating, fermenting, cooking and packaging. Many technical advances have been made in recent years in the food processing industries and freeze drying, dehydro-freezing and nuclear irradiation may soon become common practices.

Employment opportunities include those with companies which prepare fish, meat and dairy products; fruit and vegetable canneries and processors; grain and feed processors; beverage makers; and makers of specialty products.

Processes, machinery and equipment used in the food processing industry are increasing in complexity. In consequence, an increasing number of functions are demanding people with specialized skills and technical training.

These functions include the control and operation of the specialized equipment or processes within the plant itself; or the testing of raw materials, materials in process or the finished product for such qualities as uniformity, purity and acceptability.

In research laboratories, technically trained personnel assist in chemical, physical and bacteriological tests or help to develop new processes. Other functions requiring specialized training include instrumentation; the development of new or improved machinery and methods of automatic packaging; quality control; and business management such as time-and-motion studies, cost control and production planning.



Testing and inspection are important functions in food processing

Above: Test samples are taken from each batch of butter

Centre: Sugar juice is analyzed for quality

Below: Meat is graded

FOREST TECHNOLOGY

Forest technology is the scientific management and conservation of the forested areas which constitute a great part of our natural resources.

Some of the problems connected with forest technology include the study of how trees grow, where a particular species will grow best, how to ensure that continuous crops can be harvested and how to make accurate inventories of timber.

There is some degree of overlap with other technologies. Civil technicians are concerned with the problems of transportation—construction of forest roads or improvement of waterways—and mechanical technicians are concerned with mechanized handling equipment. Associated fields include wildlife management and fire prevention.

Forest technicians are employed by industrial concerns such as pulp and paper mills, primarily in Eastern Canada, and by lumber companies in the west. University-trained forestry engineers, responsible for overall control, are supported by technicians in many detailed aspects of their work. In forming the bridge between woods workers and engineers, technicians are employed in a variety of duties such as:

Timber cruising—taking inventories of forested areas.

Photo interpretation (photogrammetry)—extracting information from aerial photographs for use in surveying, inventory and road building.

Compilation work—examination of data collected in cruising to prepare forest information.

Cutting supervision—layout of areas to be harvested; blazing boundaries; marking trees; and ensuring that company and government regulations are observed.

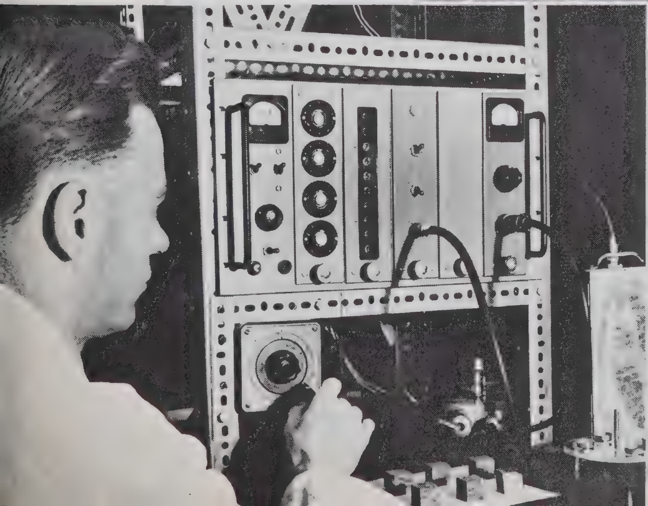
Research work—establishing experimental areas for observation of growth rates, regeneration, pest and disease damage and the many other factors which affect a forest.

In addition to adequate training, qualifications for success in forestry include the ability to meet and deal effectively with people. Many jobs also require the ability to endure vigorous physical activity, and the willingness to work in isolated areas.

Above:
A laboratory technician prepares for microscopic examination of wood-destroying fungi

Centre:
Installation of equipment to measure soil temperatures

Below:
Wood preservative is examined with the help of radio-active counters by this research technician



PAPERMAKING TECHNOLOGY

The manufacture of pulp and paper has been Canada's leading industry for many years. It stands first among all industries in value of production, exports and total wages paid.

Papermaking technology comprises three fields of work:

Conversion—primarily of wood into pulp.

Processing—of pulp into paper and paperboard.

Manufacture—of paper and paperboard into many different products such as paper bags, boxes and coated printing papers.

The increasing complexity of pulp and paper manufacturing, including mass production and large-scale output, has led to the employment of technicians with chemical, electrical, instrumentation and other scientific training.

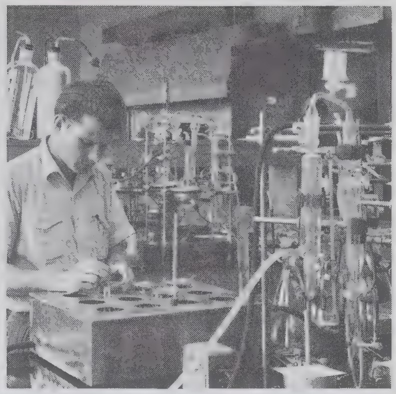
Laboratory technicians are employed in basic research into the chemistry of woods; chemical and mechanical pulping processes; bleaching and colouring; testing of materials to be added to pulp; fibre modification; stream and air pollution; and in chemical testing.

Other technicians apply their knowledge of mechanical technology to design, construction and operation problems and to the improvement of pulp and papermaking equipment. Yet others are engaged in the adaption of laboratory processes into large-scale production.

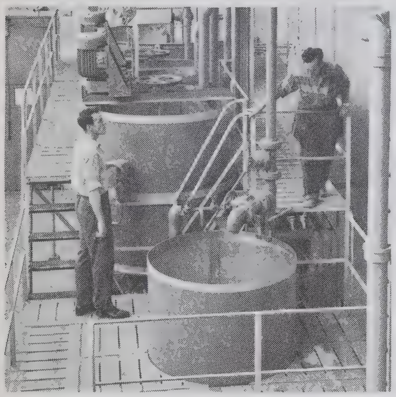
Throughout the manufacture of pulp, paper and allied products, frequent testing is carried out to determine weight, strength, colour, finish and size. Some of this work is done by machine operators but laboratory technicians, pulp testers and paper testers are employed in many mills. Tests may range from routine checks to highly-complex analyses. Other technicians in the papermaking and allied fields such as chemical and instrumentation technicians, are described in other sections of this booklet.

There is considerable variety in working conditions. Some technicians work in areas which are hot, humid and noisy. They are also exposed to odours from the chemicals used in papermaking processes. Pulp and paper companies, however, make intensive efforts to reduce heat and odours to the minimum by adequate ventilation.

Trees are measured and weighed at logging sites



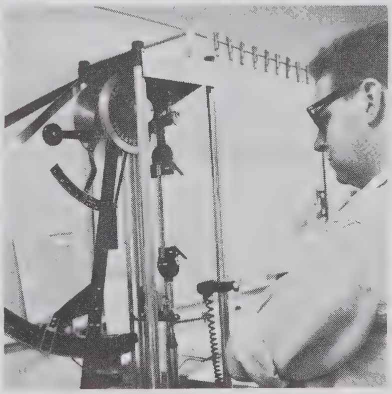
Chemical analyses are undertaken in the laboratory



New processes are tested in this pilot plant

Tests are made of the chemicals used in the making of paper

Pulp is made by hand into sheets which will be tested for strength



Paper is tested for quality, strength, resistance and whiteness

PRINTING TECHNOLOGY

Printing may be considered a universal technology for there is hardly any aspect of our daily lives which is not affected by printed material.

Four million newspapers are printed in Canada daily to keep the nation informed. Every industry, office and store uses an endless variety of forms, charts and letterheads to control processes and to keep records, while virtually every enterprise uses printed material to display or sell its products. Annually, forty million dollars worth of books, periodicals, magazines and catalogues are printed to educate, inform and entertain the reading public.

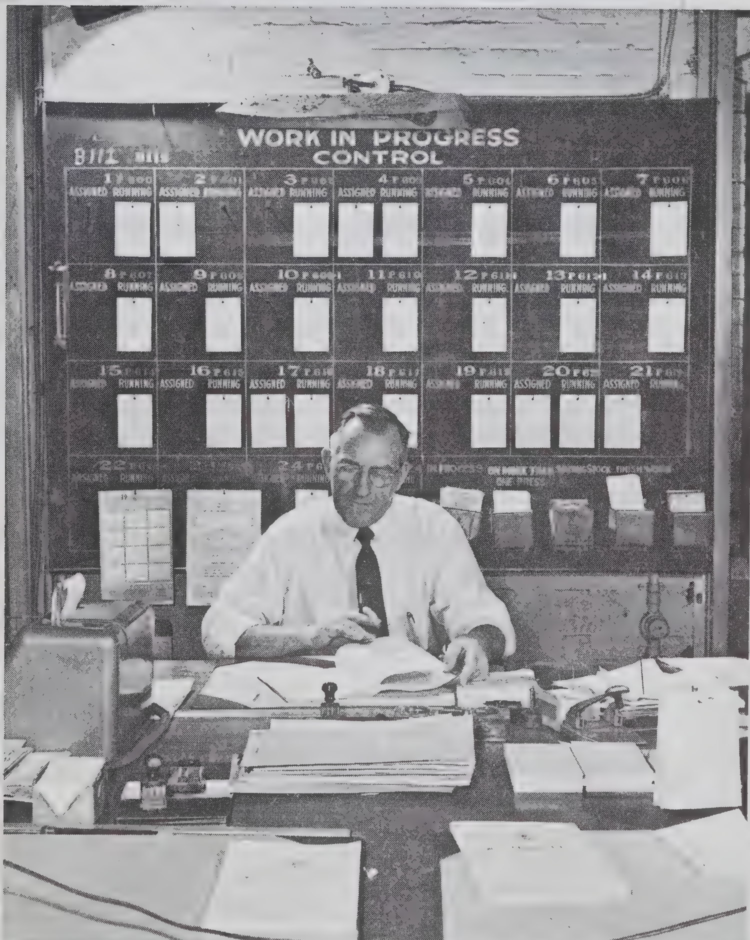
To supply this demand, Canada has over 2,800 printing firms employing a total of 31,000 people and ranging in size from small, owner-operated shops to large establishments with several hundred employees.

Many different talents are used in the printing industry. Typically artistic ability is required to design and produce illustrations, covers and layouts, or the engraving of plates and the production of photographic copy. Mechanical ability is used in the operation of presses and other printing machines while literary ability is needed in copy writing and editorial work.

There are also many other functions, estimation, production planning and inventory control, for example, which require a knowledge of mathematics and printing processes. These functions are undertaken by personnel who, for ease of understanding, can be considered under the general title of printing administrative technicians.

Printing administrative technicians are employed either in one specific function or in a combination of the following functions, depending on the size of the printing establishment in which they are employed.

For each printing job, they specify, calculate and order inks, papers, plates and other supplies; decide which printing process is to be used; measure and scale copy; estimate time factors and costs of production; and may prepare cost quotations.



For each printing job inks, paper, plates and other supplies must be calculated; the most suitable printing process decided; and cost estimates prepared

To perform these functions, they require a thorough knowledge of materials and the terminology involved; sources of supply; purchasing procedures; the kinds of records to keep and similar information.

Unlike craftsmen, they are not required to operate printing equipment; however, they must understand its operating principles, capacities, speeds and the ranges of quality to be expected.

To estimate, to interpret and to make accurate calculations, the technicians use tools, of which the slide rule is probably the most important, together with charts, scales, complex mathematical tables and standards such as those issued by the Printing Industry of America—*PAR Tables, Estimating and Printing Production Management*.

MINING TECHNOLOGY

Minerals, one of Canada's main sources of natural wealth, is exceeded in value only by forestry and agricultural products. Mining technology is the extraction of this wealth from the earth which includes:

Metallic ores of—iron, lead, zinc, silver, uranium, copper, nickel, gold and cobalt.

Non-metallic ores such as—asbestos, gypsum, fluorspar and silica.

Structural materials—gravel, stone and clay.

Fuels—coal, petroleum and natural gas.

During recent years petroleum and its derivatives, and natural gas, have become so important that they have emerged as separate technologies, with courses available in institutes of technology.

The broad field of mining includes exploration, development, surface and underground operations, milling and other primary treatments, and mine-to-market operations. Of the many different activities, here are some of the main fields:

Exploration—Technicians are engaged in geophysical and geochemical surveys, mapping and claim staking. They are also engaged in diamond drilling, logging of diamond-drilled cores, sampling and establishing ore limits.

Mine and survey office—Many technicians divide their time between the mine and the engineering office. They employ survey instruments to mark-up mine development; provide grade and direction lines for miners; establish survey baselines; prepare maps of mine development progress; calculate the tons broken; calculate ore reserves; calculate contract payments; and undertake studies of method and equipment performance.

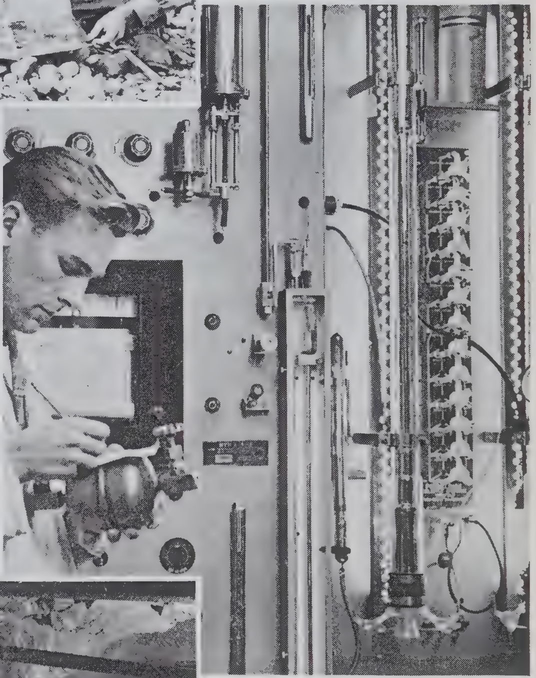
Laboratory work—In the laboratory, technicians assay mine, mill or prospectors' samples; make routine analyses of mill feed, concentrates and smelter samples. Alternatively they perform tests to control and improve processes and increase recovery.

Supervision—After they have acquired sufficient experience, technicians may become production supervisors. They will then supervise groups of miners; help train new workers; teach safety principles and lead safety programs; and schedule materials, supplies and labour. Occupations in mine supervision may lead to management positions.

Research—In recent years there has been a new awareness of the need for more research in mining practice. Extensive laboratories have been established by some of the larger mining companies, by the Government of Canada, and by some provincial governments. Technicians may assist scientists in studies related to ground pressure, methods of support, and new ways of doing operations incidental to mining. Not all research is undertaken in laboratories; methods in use can be studied in the mines.

For those interested in obtaining more detailed information on this technology, there is a booklet MINING OCCUPATIONS in this Series.

Geological survey parties undertake exploration in Canada's far North



A chemical technician tests gaseous samples from a refinery gas recovery unit

Survey instruments are used to provide lines for miners

Petroleum

With the discovery and exploitation of oil deposits in Western Canada, petroleum technology has become an area requiring specialized personnel. There are two main kinds of technician—those involved in exploration assisting geologists and geophysicists, and those involved in the actual production and preparation of oil and gas for markets. Courses at institutes of technology are designed so that graduates can enter either of these branches.

Extraction of oil from the earth is in three main stages—exploration, drilling and production.

Exploration is undertaken by small, specialized crews under the direction of geologists or geophysicists. They study the composition of the earth and undertake seismic and gravimetric surveys. Technicians in these crews include draftsmen, computers, plane tablemen and the operators of electrical and other measurement devices.

Drilling of likely sites is then undertaken to determine whether oil is actually present. Technicians, under the direction of petroleum engineers, supervise and assist in drilling operations.

Some technicians work in the district offices of oil companies and exploration firms where they interpret data collected by field crews. Most of them, however, spend a great deal of their time making field surveys often in rough and isolated sections of the country.

Most oil field work is outdoors and a sturdy constitution is needed as workers are exposed to extremes of weather. Drilling crews may expect to remain in one district for a year or so at the most; exploration personnel move even more frequently.

Crude oil as produced from the ground has very few uses. It must be transported to refining centres, usually by pipeline systems, where it goes through a manufacturing process known as refining. Natural gas is also transported by pipeline and requires treatment. Hence employment opportunities are provided for technicians with similar training in gas processing plants and gas transmission companies.

A sizable petrochemical industry has now made an appearance and offers career prospects for graduates from industrial laboratory and chemical technology courses.

Natural Gas

The industrial progress of any nation depends almost entirely on abundant and dependable sources of reasonably priced energy. Canada is extremely fortunate in having virtually unlimited reserves of natural gas in the western provinces. Exploitation of these reserves is currently in a period of great expansion. In 1960, eight per cent of Canada's total energy was supplied by natural gas. It is projected that, by 1980, this figure will reach twenty-five per cent.

Vast amounts of money are now being spent by utility companies in gas transmission and distribution systems and metering stations, and by manufacturers of industrial and domestic gas consuming equipment. This is resulting in the growth of many functions requiring mathematical and scientific skills and a knowledge of complex techniques. Typical of these are the following:

Design—Drafting of pipeline networks, distribution systems, regulating stations and metering installations; design of domestic and industrial equipment; research into such problems as corrosion.

Development—Studies of comparative fuel costs for industrial use; estimates and proposals for industrial users; selection of equipment combinations with ovens, furnaces, kilns and boilers.

Construction—Cost estimation; inspection; control of contracts; and location surveys.

Operation—Preparation of load studies; load dispatching and controlling; supervision and maintenance of control systems; and the operation and supervision of industrial and commercial gas burning and utilizing systems.

METALLURGICAL TECHNOLOGY

Metallurgy has been an important factor in the Canadian economy for many years. Today, Canada stands high among the world's leading producers of many metals including nickel, gold, zinc, silver, copper, lead, iron and uranium.

Metallurgical technology consists of two main branches. The first of these, extractive metallurgy, deals with the extraction of metals from their ores and with refining and related processes. The other branch, physical metallurgy, deals with the properties and structure of metals and their alloys, with methods of converting them into finished products, and their correct application in engineering structures.

The emphasis upon processing in Canada of the country's mineral wealth and its conversion into products, has led to the growth of many technician occupations in such industries as steel mills, foundries, metal-fabricating plants, automobile factories, pipeline companies and engine manufacturers.

Technicians in these industries assist in the following functions:

Research—Examination and testing metals and their ores; preparation of samples; development of improved alloys; collection and preparation of statistical data.

Metallography—Microscopic study of metals and their alloys.

Spectrography—Analysis of metals.

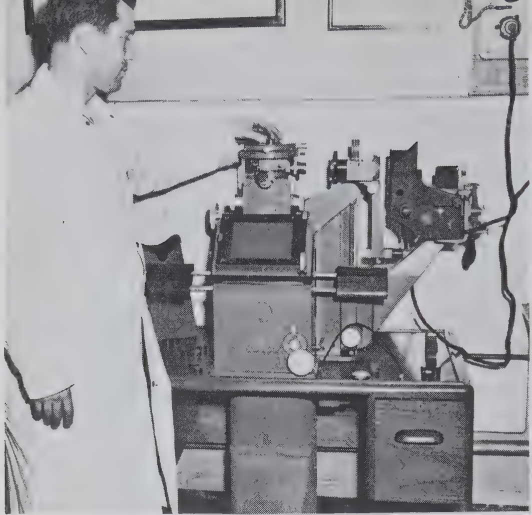
Heat treatment—Specification of procedures for hardening, tempering, annealing and other heat treatments.

Metal finishing—Specification of protective treatments and coatings.

Metal fabrication—Welding, casting, rolling, forming and forging operations.

Inspection—Determination of internal flaws by X-ray and similar methods; batch inspection tests during refining processes; tests of welds; and tests for physical properties.

Plant operation—Determination of raw materials to be fed into melting furnace and smelters, and the supervision of processes.



Examination of the structure of metals using a metallurgical microscope in the research laboratories of Dominion Engineering Limited

Chemical tests for phosphorus of an alloyed metal

Testing the high temperature properties of sand samples in a dilatometer

Working conditions will depend on the industry and, to some extent on the age of the plant. Rolling mills are hot and noisy; foundries may require exposure to heat and dirt; and technicians, near blast and steel furnaces, are exposed to considerable heat. Laboratories, inspection and supervision offices and some departments such as maintenance are clean, air-conditioned buildings.

ATOMIC ENERGY

The relatively new and growing field of atomic energy employs technicians in a number of challenging positions, primarily in basic and applied research and in the design and development of materials and equipment.

Although the field is a wide one, the many activities may be considered in three main areas: mining technology; manufacture of nuclear fuels, reactors and components (including research equipment); and the operation and maintenance of reactors.

Mining and milling of uranium-bearing ores and the refining of ores is the responsibility of Eldorado Mining and Refining Limited, a crown company with a dual role as a producer of uranium and as the government agency for the purchase of uranium mined by private companies. (The field of Mining Technology is described on page 52.)

Atomic Energy of Canada Limited, also a crown company, is concerned with the design and development of power reactors and associated equipment. Divisions of this company are also involved in the development of nuclear fuels, the production of cobalt-60 beam therapy units and other devices using radioisotopes, physics, radio and radiation-chemistry, solid-state physics and many other areas involving neutron beams and radiation.

These programs are, for the most part, carried out by scientists and engineers. Technicians are engaged in important supporting roles, of which the following are typical. There are also many secondary but none-the-less vital functions which contribute to the success of research programs.

Mathematical computations to validate designs.

Preparation of detailed drawings from design specifications.

Assembling, testing, modifying and operating laboratory models and experimenting equipment; or making special components for use in experimental or pilot work.

Fabrication and installation of electrical, electronic and instrument systems and components.

At the present time, Atomic Energy of Canada Limited (AECL) is the largest single employer of technicians; however, private industry is becoming increasingly active in many phases. The Canadian General Electric Company Limited (CGE) and AMF Canada Limited are contractors for fuel element fabrication. CGE is also the main contractor for the construction of the Nuclear Power Demonstration (NPD) station, a joint project with the Hydro-Electric Power Commission of Ontario and AECL, now being commissioned at Rolphton, Ontario.

The Hydro Commission and AECL are partners in Canada's first full-scale nuclear power-generating station (CANDU—Canadian Deutrium-Uranium) at Douglas Point on the eastern shore of Lake Ontario. Scheduled for operation in 1965, this station will have an output of 200,000 kilowatts. It is expected that when details of design, fabrication and assembly have been completed and operating techniques established, an increasing number of technicians will be employed in operation functions.

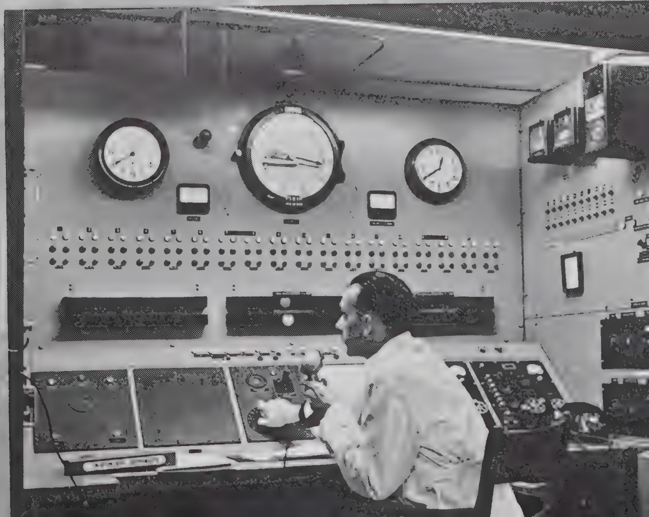
In its application to power generation, the nuclear reactor replaces the boiler of the conventional coal or oil burning station. Introduction of nuclear stations is therefore related to the availability and cost of conventional fuels and of water resources.

In the Western provinces, owing to cheap and abundant supplies of coal, oil and the untapped water resources, it is not expected that there will be nuclear power developments in the near future. However, in Ontario where most of the desirable water resources are now harnessed, nuclear power stations are being established.

Operation and maintenance of nuclear stations will probably be undertaken by Power Commissions and similar public utility companies. The number of technicians required in these functions is expected to be greater at least in the earlier stages, than conventional fuel-burning stations. This is expected partly because relatively little experience has yet been acquired and partly because of the safety precautions which are necessary.

Protective clothing is worn when handling plutonium alloy in the research laboratory of Atomic Energy of Canada Limited

The Control Panel from which the N.R.X. Reactor at Chalk River, Ontario is operated



TEXTILE TECHNOLOGY

Textiles, the industry which pioneered the industrial revolution some 200 years ago, has a long history of technical change and development. Today, because of the assimilation of the newer fibres into production and the intricacy of machines and processes, it is one of the most complex of all industrial undertakings.

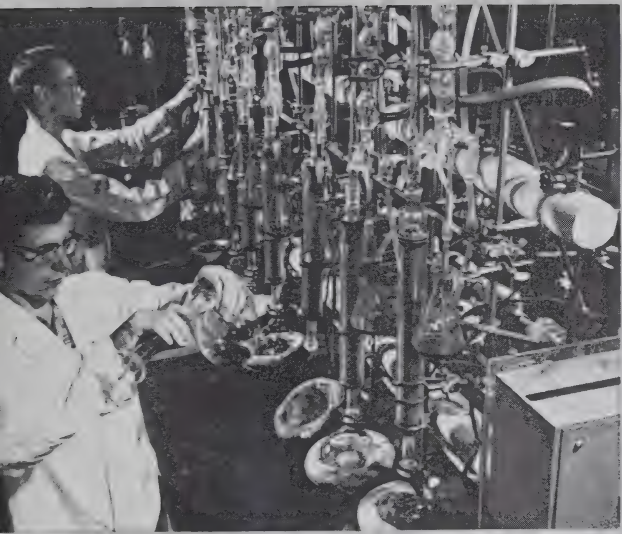
While most of Canada's textile mills, with their 80,000 employees, are concentrated in the industrial centres of Quebec and Ontario, the industry reaches from coast to coast. Producers of primary textiles include those companies which produce fibres and yarns and which convert these into woven, knitted, braided and coated fabrics for apparel uses, household furnishings, industrial uses, carpets and so on; knitted apparel; and others which dye and finish yarns and fabrics. The companies vary in size; some specialize in a narrow field such as spinning while others are highly integrated.

Such a complex industry requires the services of personnel trained in mathematics, chemistry and mechanics, with particular emphasis on their application to textile technology.

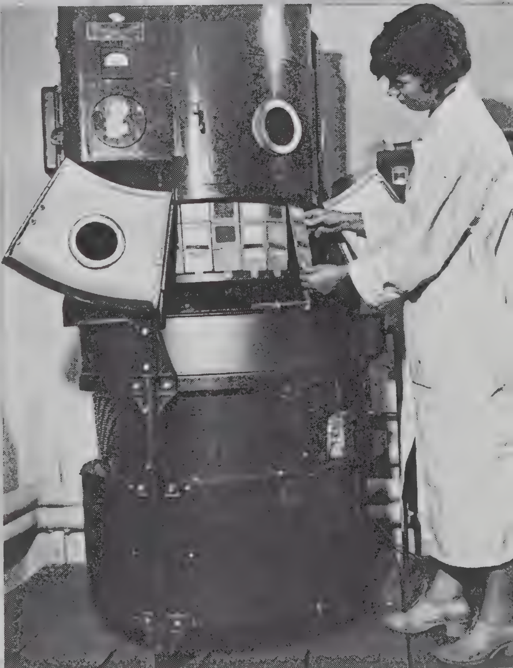
Employment openings are varied. Companies which produce fibres such as viscose, nylon, terylene, dynel, saran and orlon employ technicians with chemical training in their research and development departments. They are concerned with the problems of colour treatments, finishes and blends.

Others are employed with chemical and dyestuff manufacturing companies for development, testing and sales and service positions. Technicians trained in mechanical technology may work for textile machinery companies in the development of new techniques and equipment for such processes as spinning, warp preparation, winding, throwing, knitting and weaving.

As may be expected in a highly mechanized industry, there are the important functions of production planning and control, time-and-method study and cost estimation. These functions require a good background in mathematics together with knowledge of the



Functions of technicians in the textile industry range from basic research into new fibres, through many intermediate stages, to the testing of the final product



Above:
Research into the chemistry of new fibres

Right:
Measuring the fading effects of sunlight on dyed textiles with a Fade-orometer

principles of machine operation. Complex mathematical calculations have to be made and a variety of charts and records kept to ensure that machines and labour are put to the most economical use.

The industry pays great attention to quality control and employs a high proportion of technicians in the functions of quality control, inspection and testing. Other occupations requiring a high standard of technical training include those of textile designing, sales, buying and supervision.

The mills are nearly all modern, well-lighted and air-conditioned. They are usually located in smaller centres—more than half are in communities with less than 25,000 population—and are often the hub of social life and recreation.

When considering training routes to employment in the textile industry, there is an important fact to note. Graduates from institutes of technology meet the educational requirements for Licentiate of the Textile Institute (Lic. T.I.). Further professional improvement and experience will qualify the Licentiate for Associateship (A.T.I.) which is recognized in the industry as the qualification for management careers.

PREPARATION AND TRAINING

What are the educational and other training requirements for technicians? So varied are the tasks of technicians that it is not surprising their education and training can be obtained in many different ways. Minimum educational requirements will vary with the technology, the industry and the specific job in which the technician is engaged. It must also be pointed out that formal training schemes, such as those of the institutes of technology, provide theoretical knowledge combined with laboratory and workshop practice in complex techniques: however, as in all work of a scientific or technical nature, considerable further practical experience is necessary to become fully competent. This is acquired on the job after taking up employment and may extend over several years, depending on the complexity of the functions involved.

Graduation from an institute of technology is advocated by educational authorities, professional associations and many employers as the most suitable route to technician positions. This is especially true for positions which demand a high standard in mathematics and sciences—and most technical work in the future will make these demands. Here are a few of the many reasons why this particular route is advocated.

Many changes are taking place in industry—the new products, techniques and developments which have already been mentioned. It is expected that these changes will be even more rapid and dramatic in the years ahead.

When considering training routes, it is important to know what these changes can mean in a working lifetime. In a changing world, graduates from these institutes are at a decided advantage compared with technicians whose training has been limited, perhaps to some specific skill. Graduates, because of the theoretical knowledge gained at these institutes, are better able to adjust to changing conditions; and since they have recognized qualifications they have better opportunities for advancement. Furthermore, as technical occupations are becoming better established and more clearly defined, educational requirements are rising and a more formal type of education is being demanded.

Other training routes include: pre-employment education and training in vocational and technical high schools, followed by on-the-job training; apprenticeship schemes or in-plant training courses given by employers. These training routes may have to be supplemented by part-time, evening or home study courses.

Not all technicians have had specific training. Some workers have become technicians through private studies and on-the-job training only, while others may have had some university education.

INSTITUTES OF TECHNOLOGY

Institutes of technology offer one, two- and three-year courses after high school; three years is the usual period. Some institutes (especially in the Province of Quebec) offer a fourth year of advanced studies. Entry requirements range from grade 10 to high school graduation, depending on the province and the technology; however, most of these courses are keyed to high school graduation. High school students intending to proceed to institutes of technology should examine the educational standards required for entry into a particular institute.

Both day and evening classes are offered at most institutes; some also provide correspondence courses. Evening and correspondence tuition is of particular value to those who must have a full-time job and is also used by employed workers who wish to upgrade their knowledge.

Since technicians are primarily concerned with the application of established principles rather than the discovery of those principles, the institute programs are a combination of theoretical studies and practical training. About half of their time is spent in laboratories and workships, testing and applying the theories taught in the classroom.

Typical theoretical studies include the following:

Mathematics (advanced algebra, geometry and calculus, etc.)

Field of specialty (chemistry, physics, electricity, forestry, mining, architecture, textiles, etc.)

Related technical subjects

Communications (language composition and report writing)

Economics and social studies (depending on the technology)

Annual fees range from $60 to $250, depending on the institute and the technology. Additional expenses for such items as books and instruments cost a further $20 to $100, although most institutes operate second-hand stores. In the Province of Quebec, tuition and book costs are borne by the provincial government; consequently, no fees are charged to students residing in the province. To the foregoing must be added the cost of accommodation for those students living away from home; one institute quotes from $15 to $20 per week for room and two meals.

It must be pointed out that most courses of instruction in the institutes are terminal in nature, i.e., designed to prepare students for immediate employment on graduation rather than proceed to higher education, although a few graduates do so. Under certain conditions, graduation from an institute of technology (Province of Quebec) enables admission to colleges. Students who complete an architectural course may receive an allowance of two years towards their five years of articleship. By writing the required examinations, graduates in chemistry may qualify for full membership of The Chemical Institute of Canada. In the Province of Ontario, some credits may be given towards the examinations required for membership of the Professional Engineers Association.

APPRENTICESHIP

Training for some technician occupations such as tool-and-die maker, instrument technician or radio technician, is obtained through formal apprenticeship schemes regulated by the Apprenticeship Branch of provincial Departments of Labour.

Apprenticeship consists of training while employed together with several weeks attendance, each year of apprenticeship, at municipal or provincial training institutes to acquire theoretical related subject knowledge.

TABLE 1—EDUCATIONAL ESTABLISHMENTS

NAME OF EDUCATIONAL ESTABLISHMENT	Duration of Course—Years	Electrical	Electronic	Mechanical	Instrumentation	Chemical	Architectural	Civil	Surveying	Agriculture	Fisheries	Food Processing	Forestry	Papermaking	Printing	Mining	Petroleum	Gas	Metallurgy	Atomic Energy	Textiles	Aeronautics	REMARKS
BRITISH COLUMBIA																							
Vancouver Vocational Institute—Vancouver	2																						Two-year Advanced Technical Course
**British Columbia Institute of Technology—Vancouver	2	x	x	x	x	x	x	x	x			x	x			x	x	x	x				Broadcasting; Business Administration. Scheduled to open, September, 1964
University of British Columbia	1									x													Diploma Course
ALBERTA																							
Southern Institute of Technology—Calgary	2/3	x	x	x			x	x	x								x					x	Industrial Laboratory (Chemical): Drafting: Construction: Surveying: Automotive: Power Plant Engineering: Refrigeration and Air-conditioning
**Northern Institute of Technology—Edmonton																							Scheduled to open, March, 1963
Schools of Agriculture—Olds, Vermilion and Fairview	2									x													Diploma Course
SASKATCHEWAN																							
**Saskatchewan Technical Institute—Saskatoon																							Scheduled to open, Fall, 1963
Saskatchewan Technical Institute—Moose Jaw	2	x		x			x	x															Secretarial Science: Accounting
School of Agriculture—Saskatoon	2									x													Diploma Course

MANITOBA																							
**Institute of Technology—Winnipeg																							Scheduled to open, Spring, 1963
University of Manitoba—Winnipeg	2									x													Diploma Course
ONTARIO																							
Lakehead College of Arts, Science & Technology—Port Arthur	2/3						x						x										Engineering Technology (first year of 3 year course) Engineering Technology (both years of 2 year course)
**Northern Ontario Institute of Technology—Kirkland Lake																							Scheduled to open, September, 1962
Provincial Institute of Mining—Haileybury	2															x							
Ryerson Institute of Technology—Toronto	3	x	x	x	x	x	x	x							x			x	x			x	Sanitary Inspector's Course: Secretarial Science
The Eastern Institute of Technology—Ottawa	3	†	x	x	†	x		‡										‡	†			†	Industrial & Business Management Technology
Hamilton Institute of Technology—Hamilton	3	x	x	x	‡	‡		‡										‡	‡		x	†	Industrial & Business Management Technology
Western Institute of Technology—Windsor	3	†	x	x	‡	x		‡										‡	‡		x	‡	
Ontario Agricultural College—Guelph	2									x													Diploma Course
Western Ontario Agricultural School—Ridgetown	2									x													Diploma Course
Kemptville Agricultural School—Kemptville	2									x													Diploma Course

NOTE:
† 2 years of 3-year course
‡ 1 year of 3-year course

TABLE 1—EDUCATIONAL ESTABLISHMENTS—*Continued*

NAME OF EDUCATIONAL ESTABLISHMENT	Duration of Course—Years	Electrical	Electronic	Mechanical	Instrumentation	Chemical	Architectural	Civil	Surveying	Agriculture	Fisheries	Food Processing	Forestry	Papermaking	Printing	Mining	Petroleum	Gas	Metallurgy	Atomic Energy	Textiles	Aeronautics	REMARKS
QUEBEC																							
Institut des Arts Graphiques—Montréal	3														x								Bookbinding: Photography
Institut des Arts Appliqués—Montréal	3/4																						Furniture: Ceramics: Interior Decorating:
Institut de Papeterie—Trois-Rivières	3													x									
Institut des Textiles—St. Hyacinthe	3/4																				x		Chemistry: Dyeing
Institut de Marine—Rimouski																							Navigation (1 and 2 years): Marine Engineering (3 yrs): Wireless (2 yrs).
Instituts de Technologie: d'Arvida; de Chicoutimi; de Hull; de Lauzon; de Rimouski; de Sherbrooke; de Montréal; de Shawinigan; de Québec; de Trois-Rivières; Laval (Montréal)	3	x	x	x	x	x													x			x	Refrigeration
Macdonald College (McGill University)—Ste. Anne de Bellevue	2									x													Diploma of Technical Studies in Agriculture
Agricultural Technical Institute—Ste. Anne de la Pocatière	3									x													Diploma of Technical Studies in Agriculture
**Agricultural Technical Institute—St. Hyacinthe	3																						Scheduled to open, May, 1964
École de Laiterie de la Province de Quebec—St. Hyacinthe	3									x													Agricultural Technology

NOTE:
In addition, 29 Trade Schools across the Province offer the first or the first and second years of the technical courses.

NEW BRUNSWICK																							
New Brunswick Technical Institute—Moncton	2	x	x	x			x																Drafting: Secretarial Science: Accounting
NOVA SCOTIA																							
Nova Scotia Land Survey Institute—Lawrencetown	2								x														Leading to licence as Land Surveyor
Nova Scotia Agricultural College—Truro	2									x													Diploma Course
**Nova Scotia Trade & Technical Institute—Halifax																							Scheduled to open, Fall, 1963
NEWFOUNDLAND																							
**St. John's College of Trade & Technology—St. John's	2	x	x	x			x	x								x							Scheduled to open, September, 1963

NOTES:

(1) Establishments marked thus ** are at present under construction and complete details of curricula are not available.

(2) Not all establishments offer complete technical courses. The first or first and second years may be taken in schools serving young people near home. It is then necessary to take the final year in another centre.

(3) Many establishments are at present being extended and further courses will no doubt be added to the curricula. Reference should be made to the individual schools for more recent information.

NOVEMBER, 1962

TRAINING IN INDUSTRY

There is a wide variety of training methods in industry. Instruction may be given in formal, company-operated classrooms, supplemented by on-the-job-training. These methods are often directed towards training for a specific job or a cluster of related jobs. Workers with other companies may receive almost all of their training on the job and take their theoretical training on a part-time basis. Employers who do not provide training schemes may offer encouragement to their employees in the form of payment of fees and time off to take part-time and evening studies.

Those intent on becoming well qualified should make every effort, if they train in industry, to obtain employment with companies known to have good training programs. These firms are selective about their employees, preferring those with a good educational background and vocational or technical high school graduation.

PERSONAL QUALITIES NEEDED

What do technicians need to get ahead? In addition to the personal qualities already mentioned, technicians, no matter what their field or particular function, must possess the following "success factors" if they are to get ahead.

Ability to express themselves clearly and exactly—As in all fields of co-operative endeavour, communication between people is of the utmost importance. Technicians must take a real interest in the way in which their thoughts are expressed; they must constantly try to write correctly and clearly, and must have the habit of reading what they have written critically and analytically, to make sure that they cannot be misread or misunderstood.

A liking for and ability in the sciences and mathematics and the ability to learn complex techniques—Technical teams, in any enterprise, use sciences such as physics and chemistry; they use applied sciences such as mechanics; and they use tools of science such as trigonometry, geometry and calculus. For obvious reasons, a liking for these subjects is a prerequisite.

A genuine interest in study—There are two main reasons why this quality is important. The first is that after graduation, technicians are only part way to becoming specialists in their chosen field. Considerable work experience, involving more study, is necessary to become fully competent in a particular industry. The second reason is that technologies are changing rapidly. Further study, probably throughout the technician's lifetime is necessary to keep up with these changes.

Accurate and careful nature—The ability to take accurate readings and careful measurements is essential, as is the ability to make a sound assessment of those readings.

Persistence and patience—Often technicians are called on to prepare drawings, make calculations or set up complex equipment over and over again before the next stage of development can be carried out. The qualities of persistence and patience are therefore needed to see a problem through to its final conclusion.

Ability to get along with others—In all teamwork the ability to get along with others is a key factor to success. In addition, technicians are often in supervisory jobs and, at times, are called on for leadership.

Finally, technicians must be willing to get their hands dirty once in a while and be prepared to undertake some of the tasks of the bench hand.

TABLE 2—TYPICAL OCCUPATIONS

These occupations are well within the reach of good technicians after several years experience in industry	Electrical	Mechanical	Instrumentation	Chemical	Architectural	Civil	Forestry	Papermaking	Mining	Metallurgical	Aeronautical	Textiles	Others
Acid tester				x									
Aerodynamicist											x		
Air traffic controller											x		
Amalgamator										x			
Annealing foreman		x								x			
Boss miner									x				
Broadcasting technician	x												
Chemical tester				x									
Technical librarian	x	x	x	x			x	x	x	x	x	x	
Cloth tester												x	
Contractor—building	x					x							
Control supervisor	x		x							x			
Computer design technician													x
Clerk-of-works					x	x							
Camera technician													x
Dairy technologist													x
Draftsman	x	x	x	x	x	x	x	x	x		x		
Designers—													
machine tools		x									x		
fixtures		x											
jigs		x											
industrial machines		x											
Driller—seismograph									x				
Dyer—textiles												x	
Estimator	x	x	x		x	x	x				x		
Foreman	x	x	x	x	x	x	x	x	x	x	x	x	x
Geodetic computer									x				
Heat treatment technician		x								x			
Inspector	x	x	x	x	x	x				x	x	x	
Instrument technician	x	x	x	x				x	x	x	x	x	
Instructor—vocational													x
Illustrator—technical	x	x	x								x		
Illustrator—scientific				x			x						x
Job captain					x								
Model maker	x	x	x	x	x	x					x		
Maintenance engineer (licenced)											x		
Meteorological technician													x
Metallographer										x			
Mine captain									x				
Oils tester									x				
Pulp tester								x					
Power plant engineer	x	x											
Production manager	x	x	x	x				x	x	x	x	x	x
Production planner	x	x	x	x				x		x	x	x	x
Purchasing agent	x	x	x	x	x			x		x	x	x	x
Quality control manager	x	x	x	x				x		x	x	x	x
Radar technician	x												x
Recording engineer	x												
Surveyor					x	x	x		x				
Stationary engineer (certified)	x	x							x				
Sand technician										x			
Seismic computer									x				
Spectroscopist			x	x						x			
Soil technologist													x
Supervisor	x	x	x	x	x	x	x	x	x	x	x	x	x
Teacher—vocational	x	x	x	x	x	x	x	x	x	x	x	x	x
Teacher—technical	x	x	x	x		x	x	x	x	x	x	x	x
Technical writer	x	x	x	x		x				x	x		x
Television studio technician	x												x
Technical salesman	x	x	x	x				x		x		x	x
Time study analyst	x	x	x	x		x		x			x	x	x
X-ray technician (industrial)	x	x								x			x

ADVANCEMENT

Advancement for technicians can lead to three types of position: another technician job at a higher paying level; a supervisory post in the technician group; or, with further experience and training, a job in the managerial ranks.

For ease of understanding, here are a few examples:

Design and Development—detail draftsman—design draftsman—checker—to Chief Draftsman.

Aeronautical Technology—detail inspector—flight inspector—and, after obtaining Department of Transport Aircraft Maintenance Engineers Licences, to Chief Aircraft Maintenance Engineer.

Civil Technology—design draftsman—scheduler—Estimator/Superintendent.

Production Planning—scheduler—estimator—buyer—Chief Purchasing Agent.

As in most kinds of work, advancement depends on such factors as job performance, capacity for higher level work and seniority. However, probably the most important single factor is the level of educational attainment.

It should be noted that the role of technicians, because of their specialized education and training, is that of assisting in a team, each team usually being headed by a member of the professions such as an architect, a chemist, an engineer or a biologist. There is very little doubt that technicians in certain functions such as research, design and development, find their promotional opportunities limited unless they obtain the further education and training required to enter the professions.

TECHNICIAN OR "PROFESSIONAL"?

While it is not the intention of this booklet to consider at any length the complex problem of vocational choice, it is considered necessary to point out certain factors which must be examined *before* any course of training is selected. Proper selection at this stage will avoid possible future disappointments.

There are two personal factors to consider: the role for which you are best suited and, secondly, your ambitions for future advancement. Your future will depend, in some measure, on the training route you first select. Your talents may best lead to a position, possibly a supervisory one, in the technician group: alternatively, you may have the intellectual capacity to train, via the university curriculum, for a professional career. As a third alternate, you should examine whether a marked interest in practical work would not be better utilized as a craftsman or production worker.

Courses in institutes of technology are designed for young people who:

1. Have a vital interest in the practical as well as some interest in the theoretical.
2. Are not expected to have the intellectual capacity for a university course.
3. Cannot afford university training viz., one or two years longer than the institute of technology; fees ranging from $300 to $600 compared with the $250 of the more expensive institutes.
4. Are not acceptable in university because their mathematics and sciences do not meet entrance requirements.

This, it is hoped, points up the significant differences between the requirements of the university and the technician's course of study.

There are other booklets in this Series—CAREERS IN NATURAL SCIENCE and CAREERS IN ENGINEERING—which are recommended reading if you require further information on these professions.

EARNINGS

The earnings of technicians vary from region to region, from industry to industry and with the degree of responsibility. In addition, job titles have different meanings for different employers. For example, in one company, an engineering aide may essentially be a statistical clerk; in another firm he may undertake duties of a highly technical nature. For these several reasons, comprehensive data cannot be included. In general, pay scales range from a starting rate of $3,600 rising to $8,000 per year for those with several years of experience. A few cases have been reported of institute of technology graduates receiving salaries in excess of $10,000 per year.

ORGANIZATIONS

At the present time, there are many different organizations for technicians; some are well established, others in the formative stages while others represent technicians in a particular province, industry or function. For this reason, only typical organizations can be given.

In the province of Quebec, the CORPORATION OF PROFESSIONAL TECHNICIANS OF THE PROVINCE OF QUEBEC (*Corporation des Techniciens Professionnels de la Province de Québec*) has been established over the past thirty years. By provincial legislation, the exclusive right to the titles *Certified Technician* (*Technicien Diplômé*) and *Professional Technician* (*Technicien Professionnel*) with designatory letters *certified technician,* C.T. (*technicien diplômé,* T.D.) and *professional technician,* P.T. (*technicien professionel,* T.P.) is held by members of the Corporation.

In the province of Ontario, the Association of Professional Engineers of the Province of Ontario operates a certifying scheme for several grades of technicians and a senior grade of technologists; academic qualifications are required together with practical experience which must be under the direction of registered professional engineers. A direct outgrowth of this scheme is the ASSOCIATION OF CERTIFIED ENGINEERING TECHNOLOGISTS AND TECHNICIANS OF ONTARIO. Similar schemes are under consideration in other provinces.

On a national scale, The Chemical Institute of Canada has established a certification scheme for chemical technicians and technologists.

Technicians in the aeronautical and related fields (e.g., electronic, metallurgical and the like) may obtain membership, in grades appropriate to their qualifications and standing, in the CANADIAN AERONAUTICS AND SPACE INSTITUTE.

One bargaining union, of which a number of technicians such as draftsmen and tool designers are members, is the AMERICAN FEDERATION OF TECHNICAL ENGINEERS, AFL-CIO.

EMPLOYMENT OUTLOOK

There is, at the present time, an unsatisfied demand for technicians and the employment outlook is excellent. Technicians are utilized by the fastest growing industries and employment opportunities have been far in excess of the supply from Canada's 29 establishments for technical education. Significant of future employment trends is the provincial/federal building program to increase these establishments to forty in the near future; this indicates that federal and provincial authorities anticipate a doubling of employment opportunities within the next few years.

For the future, there is a lack of precedent upon which to base exact predictions since technicians are a relatively new and evolving group. Probably the most important factor governing employment opportunities will be the rate of introduction of new machines, processes and products and similar technological development.

There can be no doubt that, with a continuance of the present rate of technical changes, employment opportunities for technicians will accelerate over the next decade. In addition, technicians with sound education and well qualified in their particular field will be better able to adjust to changing conditions and thus maintain employment: workers with limited skills may not.

SEEKING EMPLOYMENT

Institutes of technology have placement officers who, in co-operation with the local offices of the National Employment Service, arrange interviews with prospective employers and bring vacancies to the attention of students and graduates. Assistance is also available to students seeking employment during vacations and those who require casual employment during the academic year. Many students make contacts while working in this summer and part-time employment which often lead to permanent employment on graduation.

Vacancies, both for new entrants and those seeking to change jobs, are listed by the National Employment Service; they can also supply much additional assistance such as details of the latest salary scales, working conditions and prospects in a particular locality.

Government at all levels—municipal, provincial and federal—and the three branches of the Armed Forces, employ many technicians. Canada-wide competitions for federal government positions are advertised in public buildings, such as post offices and local offices of the National Employment Service, and the daily newspapers.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the experts in many fields for their technical advice and comments during the preparation of this booklet. Much of the scope and authenticity of the material is due to the cordial co-operation of the following organizations, individual companies and government departments.

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Canadian Institute of Forestry
Canadian Institute of Mining and Metallurgy
Canadian Institute of Surveying
Corporation of Professional Technicians of the Province of Quebec
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Director of Vocational Education, Sask.
Assistant Superintendent of Secondary Education, Ont.
Director General of Studies, P.Q.
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National Research Council
Provincial Institute of Mining, Ontario
Royal Architectural Institute of Canada
Ryerson Institute of Technology
Shell Oil Company of Canada Ltd.
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The Canadian Council of Professional Engineers
The Canadian Manufacturers Association
The Chemical Institute of Canada
The Engineering Institute of Canada
The Southern Alberta Institute of Technology
The Textile Technical Federation of Canada

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CANADIAN OCCUPATIONS FILMSTRIPS

The Department of Labour has prepared, to date, the following occupational filmstrips in collaboration with the National Film Board. A manual has been prepared as an accompaniment to each filmstrip. These may be purchased from the National Film Board, Box 6100, Montreal, or from any one of its regional offices. Prices in Canada: $4.00 for colour; $2.00 for black and white.

Plumber, Pipefitter and Steamfitter

Careers in Engineering (revised in colour)

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Bricklayer and Stone-Mason

Printing Trades

Careers in Natural Science (revised in colour)

Careers in Home Economics

Motor Vehicle Mechanic

Mining Occupations

Draughtsman

Careers in Construction

Machine Shop Occupations

Sheet-Metal Worker

Careers in Meteorology

Medical Laboratory Technologist (in colour)

Teacher (in colour)

Office Occupations (in colour)

Electrical and Electronic Occupations (in colour)

Careers in Library Service (in colour)

Electronic Computer Occupations (in colour)

TECHNICIANS IN SCIENCE AND ENGINEERING

Monograph No. 48

TECHNICIANS IN SCIENCE AND ENGINEERING

Research

Inspection

Installation

Sales & Service

Production Planning

Design & Development

Teaching & Instruction

Operation & Maintenance

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Careers in Natural Science
Teacher
Office Occupations
Electronic Computer Occupations
Careers in Library Service
Medical Laboratory Technologist

Black-and-White (only)
Price $2.00 each*

Bricklayer and Stonemason
Sheet-Metal Worker
Machine Shop Occupations
Printing Trades
Motor Vehicle Mechanic
The Social Worker
Mining Occupations
Draughtsman
Careers in Home Economics
Careers in Construction
Careers in Meteorology

***Prices in Canada**

Canadian Occupations
Monograph 48

TECHNICIANS IN SCIENCE AND ENGINEERING

Prepared
by the
Economics and Research Branch
of the
Department of Labour, Canada

HON. ALLAN J. MacEACHEN
Minister

GEORGE V. HAYTHORNE
Deputy Minister

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FOREWORD

During recent years there has been a steadily increasing demand for Canadian occupational information. The demand comes from young people faced with the need of choosing an occupation and preparing for it; from parents, teachers and vocational guidance counsellors; from workers wishing to change their occupations; from employment service officers; from personnel directors and union officials; from prospective immigrants to Canada and from other quarters.

THE CANADIAN OCCUPATIONS series of monographs is designed to help meet this demand. Each booklet describes, among other things, the nature of the occupation or groups of occupations, entrance and training requirements, working conditions and employment outlook.

The series has been prepared with the generous assistance of representatives of management, trade unions and professional associations. The co-operation of the Unemployment Insurance Commission, the Technical and Vocational Training Branch of the Department of Labour, and the Dominion Bureau of Statistics is gratefully acknowledged.

Occupational information tends to become dated as a result of changes in economic conditions, in industrial technology and in wage and salary structure. Revision of outdated publications is a regular feature of the series.

This booklet was prepared and written for the Manpower Resources Division by William Coe under the direction of William Allison, Head of the Occupational Analysis Section.

The branch is greatly indebted to the many organizations and companies whose assistance made this monograph possible.

J. P. FRANCIS,
Director,
Economics and Research Branch,
Department of Labour.

January 1963

Front Cover:

Defence Research Board technicians ready a prototype of Canada's "Topside Sounder" satellite for simulated space environmental tests. Lights provide heat to test the hundreds of black solar cells used to supply power

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TECHNICIANS IN SCIENCE AND ENGINEERING

HISTORY AND IMPORTANCE

Air-conditioned homes, television sets, electric stoves and washers, the man-made fibres in the clothes we wear—even the most casual glance around us will quickly indicate that we are living in an age of science and technology.

Scientists are reaching into the future to discover new laws and principles; engineers are applying those laws and principles to provide us with a myriad of goods and services which were unknown at the turn of the present century.

But as attention is drawn to the works of scientists and engineers, history often tends to overlook the vital contributions of other workers. Scientific discoveries and engineering achievements and, indeed, any project which will add to our material well-being, require the services of many people with varied backgrounds and with many different kinds of skill, knowledge and experience. This booklet is devoted to one particular group—THE SCIENTIFIC AND ENGINEERING TECHNICIANS—which has a major role in helping to translate scientific and technical ideas into usable products and services.

The term "technicians" may be new to you. They first appeared during the industrial revolution of the mid-18th century and, in 1833, the term reached the dictionary to define "a person skilled in the technicalities of some subject". But it was not until the present era of technological change that their importance has been recognized.

With its tremendous advances in scientific and technical knowledge, the 20th century has heralded a new way of life. This is the age of nuclear energy, of space travel and of mass-production and automation. These advances have caused significant changes in employment, particularly the emerging importance of technicians. Erection of a modern skyscraper, the development of a missile site, or the operations of an enterprise with an output of hundreds of products for thousands of customers, demand the services of specialists. These specialists include our modern technicians and they require not only practical skills but also a theoretical knowledge of their specialty.

On the Canadian scene, our rapid post-war industrialization has greatly changed the employment structure of the nation. In our factories, offices and in almost every section of our business and industry, many time-honoured skills are in less demand and a new group of occupations is arising.

So rapid has been the growth of this group of occupations that, at the present time, there is little uniformity in either job duties or titles. Depending on the industry, and often on the individual employer in that industry, they may be known by the work they do (inspector or material analyst) or by the equipment they use (geophysical computer or X-ray technician). In the province of Quebec, graduates of institutes of technology are known by provincial legislation as certified technicians and professional technologists. In many provinces, titles such as stationary engineer and aircraft maintenance engineer also have legal standing. While those who in industry are called technicians may be in duties ranging from little more than routine technical work to assignments akin to those of engineers and scientists.

At the present time the preparation of interprovincial titles, probably related to educational qualifications, is being investigated. However, until definite titles are forthcoming, there is no alternative but to use the term of convenience—technicians—in this booklet.

The technician occupations which will be described are similar in that certain sets of principles must be learned and a degree of skill acquired to apply those principles to actual situations; this knowledge is of a type which cannot be picked up in the course of a normal day's work. Therefore, *the term "technician" as used in this booklet applies to occupations which require a knowledge of physical sciences, engineering and mathematical subjects such as can be obtained by completion of a prescribed course of study at an institute of technology, or its equivalent in part-time studies.*

When reading the following pages, you should bear in mind that it is not possible to cover all aspects of this very wide group of occupations in this booklet. Should there be a technology on which you require further information, it is suggested that you read other booklets in this Series (listed on the inside cover). These give more detail on certain fields of work.

NATURE OF THE WORK

What do technicians do? Before the nature of the technician's work can be understood, it is first necessary to explain the "technical team", the team members and how they arrived in their different roles.

At the turn of the century, invention and production were separate realms each concerned with its own particular interests and problems. Science was the function of the universities; production and distribution were the province of the manufacturer; and inventors, it is said, lived solitary lives in garret or cellar workshops.

Today, this simple picture is no longer true. Because of technical changes—more complex goods, more complicated methods of manufacture, automation and mass production—the "team approach" has developed.

In one sense the whole operation of a company can be looked on as that of a single large team. Use of the term is however restricted to smaller units each containing specialists related to each other by the fact that they are working towards a common objective—research, design, production and so on.

Each team, approaching a problem from its own particular angle, consists broadly of three occupational groups: (1) the professions i.e., architects, engineers, scientists such as biologists, chemists, and similar workers; (2) technicians at varying levels of skill; and (3) craftsmen and other production workers. Each group, having travelled a different training path, is in a different though related role.

The university, traditionally, is the training ground for the professions whose role in formulating new ideas and organizing and directing the technical team requires a broad and deep theoretical knowledge of their chosen field.

Technicians, in contrast, require a more specialized kind of theoretical knowledge together with practical training in complex techniques for their role as link between the professions and production workers. Provincial institutes of technology provide a training route to technician careers. The institute programs are usually more completely technical in content than the university although both deal with the same general fields. In addition, training may also be specialized to suit the needs of industry in a particular geographical region, i.e., papermaking, textiles, mining, etc.

Craftsmen and production workers require manual skills to make the products and perform the desired services and are trained through apprenticeship and learnership. Apprenticeship consists of training on-the-job under the guidance of an experienced craftsman together with several weeks of full-time classroom study each year of apprenticeship. Learnership is similar but usually without benefit of formal classroom tuition.

The difference between theoretical knowledge taught in universities and in institutes of technology is significant in that this difference determines the respective roles of graduates. Through graduation from the institutes, technicians acquire sufficient theoretical knowledge plus practical skills for the job in hand without necessarily having complete mastery of that theory. For example, electronic technicians in the function of inspection have sufficient theoretical knowledge to interpret instrument readings and diagnose faults; they will not require the depth of knowledge to discover new electronic theories—this is considered the role of the scientist—nor to design a new broadcasting transmitter.

Thus by virtue of their training the main role of the technicians is to undertake some detailed aspects of the scientist's or engineer's work which would otherwise be done by them. In doing so, they are usually the link between professions and the production workers in the functions about to be described.

RESEARCH

Research teams require the support services of many technicians as well as co-operation between scientists such as metallurgists, and chemists, and engineers.

For technicians, a wide variety of duties is involved. At the highest level, a knowledge of complex techniques founded on an adequate theoretical knowledge is demanded. The range goes through many intermediate levels to that of routine tasks.

Typically, they assist scientists in programs of patient, carefully assessed experimentation. More particularly, they help design, make and operate special test equipment such as stress, motion, strain and other devices used in building, mechanical or aeronautical technologies. Others may use their mathematical and scientific training to assist in the analysis of experimental data.

Others such as laboratory technicians in physical science or biological laboratories prepare samples by marking, measuring and weighing or work with chemical scientists in qualitative and quantitative chemical analyses. The analyses of metals, viscosity of oils, structure of textile fibres and the composition of soils, are but a few of many examples. While laboratory aides undertake work which, although technical in nature, may be more routine and record results in the form of graphs and charts.

Most research is carried on in laboratories which vary greatly according to the industry and the importance attached in that industry to research functions. Some laboratories are clean, well-lighted buildings while others may be crowded with apparatus. Such dangers as may exist from handling chemicals, radioactive and similar materials are kept to a minimum by following tested and accepted procedures.

In addition to academic ability, research technicians require persistence and patience. Many thousands of experiments may be necessary before an end result is achieved, although no experiment is really wasted. To these qualities must be added those of resourcefulness and ingenuity—to make, and operate experimental equipment perhaps unlike anything built before.

DESIGN AND DEVELOPMENT

Design and development teams are concerned with the problems involved in the production of new tools, products and services, or in making improvements to those already in use.

Initial concept of a new product or service is the function of a designer who may be an architect, an engineer, a scientist or similar worker. Design functions delegated to technicians are usually limited to the many details which make up the final product.* With improvements to existing products, technicians undertake design following established techniques in the form of specifications, standards and similar technical data and prepare new designs in the light of established practices.

Draftsmen who predominate numerically in these teams produce drawings, assembly and installation instructions, and similar information from which production workers can make the products or perform the services. They require not only an adequate knowledge of drafting techniques but also thorough training in their particular technology. For example, electronic draftsmen require a knowledge of physics as related to the generation, propagation and amplification of electromagnetic waves.

Mechanical draftsmen make calculations not only in respect to the dimensions of an object but also of weight, strength and factors such as gear ratios. Therefore in drawing plans for machines and other mechanisms, they require a knowledge of physics, mathematics and the properties of metals.

Construction draftsmen must have a knowledge of building materials, theory of structures, contracts and specifications together with the mathematical training to undertake calculations associated with the design of steel and reinforced concrete structures.

** This limitation is particularly true in certain engineering fields. Where the term "design" is used in describing technicians' work in this booklet, it is intended to mean the functions given in these paragraphs and not those of design which, by provincial legislation, can only be undertaken by a member of a professional engineers' association.*

No matter how complicated the structure, or how simple the item, design and development starts here on the drawing board using the tools of science—geometry, trigonometry and calculus

Drafting, undertaken sitting at a table, is light work. It requires good eyesight and neat workmanship and the ability not only to visualize the item being drawn but also its relationship with other items in the final product.

Others in this team include development technicians who make working models, pilot plants and similar prototypes for testing purposes or to determine production methods. They are frequently highly skilled in the work of craftsmen, in machines and in industrial processes. Alternatively, they may be engaged in the reduction of test results into mathematical data.

Still other technicians are employed on liaison duties between the design offices and production departments; they examine any apparent drawing errors, may give concessions for alternative materials and processes and, in general, ensure smooth working between design and production teams.*

INSTALLATION

Enterprises such as telephone, electrical, air-conditioning, electronic computer and business machine companies, often install their own equipment in customers' premises. This is the work of teams of technicians and craftsmen although, on larger projects, the work may be supervised by an engineer. For technicians, this work involves a high degree of competence in craftsmen's skills.

They bring equipment into operation; ensure that it functions correctly; and diagnose and eliminate faults. After the equipment has been installed, technicians may be required to instruct customer employees in its use and, later, to make periodic maintenance visits.

Personal qualities include a neat appearance, clean work habits and the disposition to maintain friendly customer relations. They must be painstaking and pay great attention to detail so that the installations will operate with the minimum of inconvenience to the customer.

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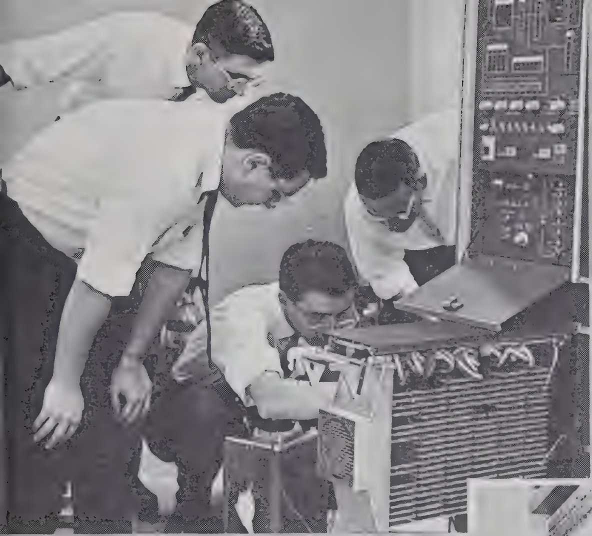
*For those interested in obtaining more detailed information, a booklet CAREERS IN DRAFTING is available in this Series.



Typical installation work—

Above:

Computer devices and data processing units are installed by business machine companies

Centre:

A central office switchman tests a new installation in Alberta Government Telephones

Below:

An 18,500 KVA generator is installed in a hydro-electric power station

OPERATION AND MAINTENANCE

Groups of technicians are employed in the operation and maintenance of enterprises such as telecommunications systems, radio and television stations, electrical utilities and oil refineries.

Their main task is to ensure that correct operating procedures are followed. This work often includes servicing and overhaul and bringing new installations into operation and sometimes offers opportunities for development, in thinking out improvements, or dealing with different circumstances and requirements.

Other occupations include those of stationary engineers for which courses are available in institutes of technology. Provincial regulations require certification of engineers before they assume responsibility for power plant operation. They are in charge of and operate the steam-powered engines, compressors and other mechanical equipment in hospitals, office blocks and similar large public and commercial buildings, and in industrial enterprises such as thermal-electric, power-generating plants.

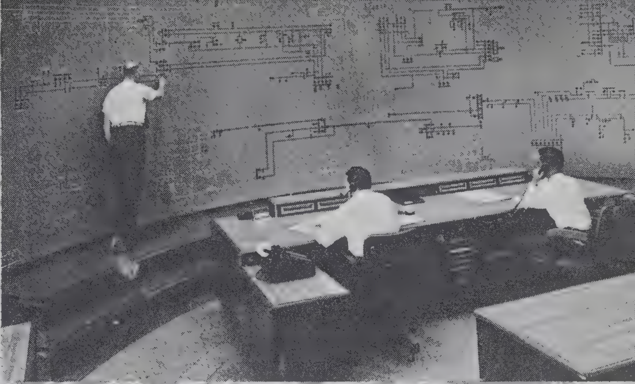
INSPECTION

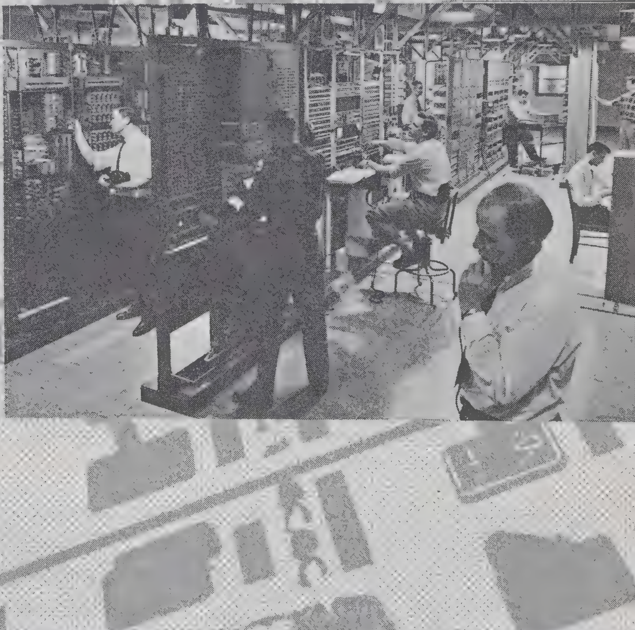
With the increasing complexity of many materials and processes, together with the demand for better goods and services, quality control has assumed great importance at all stages of manufacture and construction. It ranges from the examination of raw materials, through many intermediate stages, to the testing and functioning of the final product.

The work of inspection teams requires a variety of differing skills but may be considered in the broad terms of quality control, testing and inspection.

For those interested in obtaining more detailed information on plant operation, including power generation, telecommunications and broadcasting, a booklet ELECTRICAL AND ELECTRONIC OCCUPATIONS is available in this Series.

In electrical power stations, the output is regulated by the load dispatching group from the systems operating office





Teams of skilled technicians operate the electronic equipment at a main mid-Canada Line communications centre

In both radio and television broadcasting, technicians operate and maintain transmitting equipment

Quality control is usually the responsibility of the chemist, architect or engineer. Testing involves the use, by technicians, of electronic and similar measuring devices. Inspection in general is more routine and involves visual examinations or checks using mechanical tools such as micrometers, rules and gauges.

The kind of material to be tested and inspected depends on the industry in which they are undertaken. It may be the viscosity of oil; the strength and printing qualities of paper; the examination of a building for conformity to government regulations; or the checking of vehicles for safety.

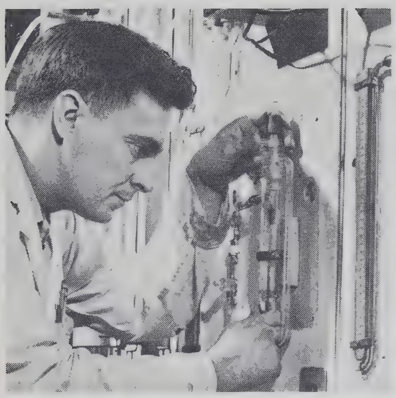
Quality control offices, view rooms and test laboratories are usually quiet, well-lighted buildings. In process inspection, technicians will meet the conditions prevailing in a particular industry. These could be the heat of a foundry, wet or cold weather of the construction industry or the jet engine noise associated with the aeronautical industry.

Confidence in their knowledge and judgment, and the ability to make sound decisions are important personal qualities. Integrity and a strong character combined with the ability to get along with others are needed when items have to be rejected for defects.

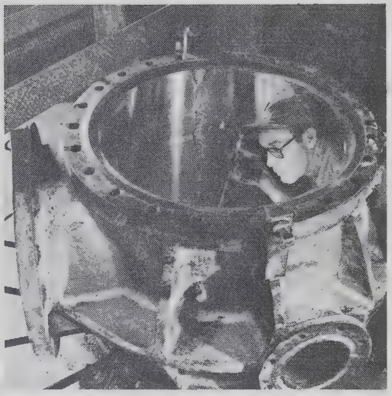
PRODUCTION PLANNING

Whether in the production of a single item such as a building, or the factory production of many similar items, planning is essential. It ensures the orderly arrangement of plant equipment, machine tools, purchase and supply of materials and the organization of production workers.

Ensuring that a project will move ahead according to a planned schedule is the function of production planning teams. The manufacturing industry employs many specialized technicians in this kind of work. In construction, stages of work are planned so that

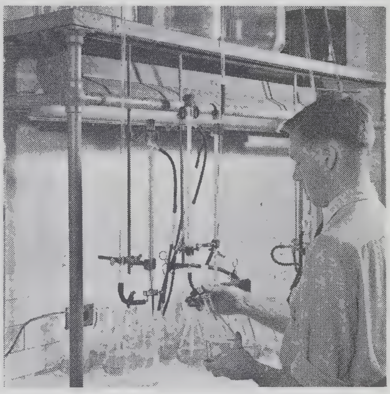


A process sample from an oil refinery unit is analyzed for quality

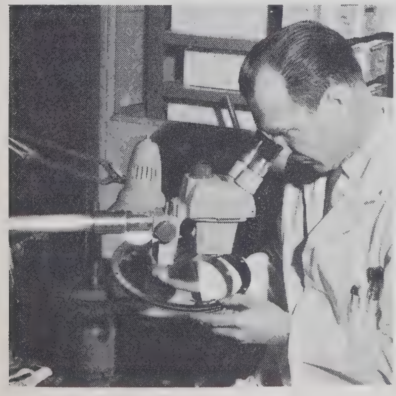


Inspection of a digestor valve used in the paper-making industry

Dimensional checks on jet engine turbine blades



Titration of a grain distillate to determine protein content



Investigation into cause of failure of a turbine engine air seal

Inspection is important in food processing

the most economical forces of men and machines are kept fully employed and materials are delivered when needed. Occupations for technicians include the following:

> *Production planners* analyze design drawings to determine the necessary operations and the equipment, machine tools and kinds of production skills involved.
>
> *Tool designers and tool draftsmen* in manufacturing plants design dies, fixtures and similar tools for production purposes. Such factors as material to be used, strength requirements, and tolerances and clearances are taken into account.
>
> A further group of technicians, including *estimators* and *time-study planners,* ensure by careful analysis and planning of details that a project is scheduled through various operations in the correct and most economical sequence.
>
> Procurement of raw materials and other supplies is the function of *purchasing agents, buyers, material planners* and their clerical assistants.

Production planning calls for a thorough mastery of production techniques. For this reason many technician positions are now held by highly skilled craftsmen. Many production problems need an understanding of time-and-motion measurement, statistical control and operations research and may also require knowledge of computing devices.

This work is undertaken in office surroundings although frequent visits to the various production departments, with their attendant noise, heat and similar conditions, are required.

Probably the most important personal qualities needed are accuracy, an inquiring mind, tact and the ability to work under pressure. Tact is necessary when standards for production workers and target dates for clients are set; technicians should always be investigating ways to improve production; ability to work effectively under pressure is necessary to avoid production delays.

TECHNICAL SALES AND SERVICE

There is a wide field of employment for sales representatives to inquire into the requirements of potential customers for technical equipment, consider the means by which these needs can be met, and supply technical data to their employers on which design and estimates can be based.

Technicians who enjoy meeting people and who possess sufficient technical knowledge to deal with the varied problems of their clients are being employed in increasing numbers. They must be competent to discuss operation, modification, repair and maintenance of equipment already installed as well as that they are seeking to supply.

Since sales personnel must be able to meet and get along with many kinds of people, certain traits of personality and appearance are necessary. In addition to technical ability, pleasant but forceful personalities who make a favourable impression in manner, speech and dress are the most likely to succeed.

Technical Publications

The preparation of technical publications is the responsibility of the technical publications supervisor, who is often attached to the Technical Sales and Service Department. He has a staff of technical writers and illustrators who compile and illustrate maintenance, operation, spare parts and instruction manuals. These are prepared from drawings, specifications and the writer's own knowledge of the operating principles of a company's products.

The ability to write clear, concise and accurate technical information is an important quality demanded of technical writers, as are the ability to discuss problems with all levels of workers, a good memory, initiative and resourcefulness.

Technical illustrators require sufficient creative ability to prepare perspective, dimetric and similar projections from engineering drawings. Accuracy and a knowledge of mathematics are essential as technical illustrations, unlike those of the "fine arts" field, must be drawn exactly to scale. A knowledge of printing and other reproduction processes is also an asset.

TEACHING AND INSTRUCTION

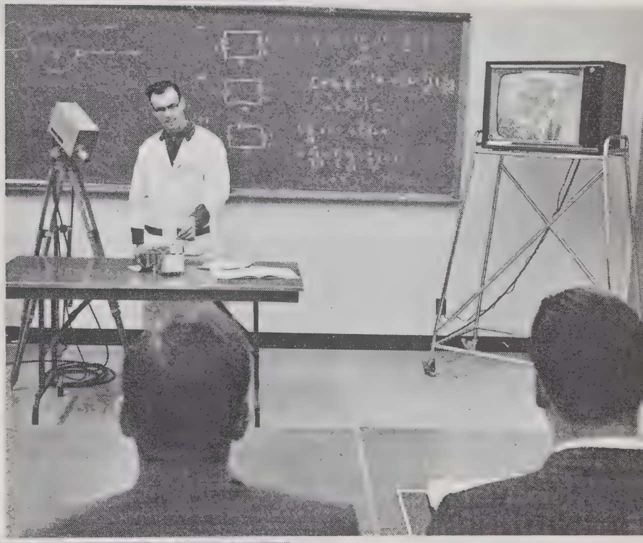
In industry, techniques often change as new products or improvements to existing ones are introduced. These changes may necessitate the retraining of employees. The teaching of these further skills is often delegated to technicians who may be employed as instructors either on a part-time or a full-time basis. This instruction varies considerably, ranging from instruction periods in company workshops to full-time tuition in well equipped classrooms with every modern convenience.

Teachers in trade and vocational schools require an extensive knowledge and skills in the trade being taught in addition to the necessary background in academic subjects. For this reason, teaching positions are often filled by technicians and craftsmen who have transferred from industry. Those employed in publicly operated schools must hold a teaching certificate which can be obtained by attendance at summer schools, or through full-time day courses of six to ten months' duration.

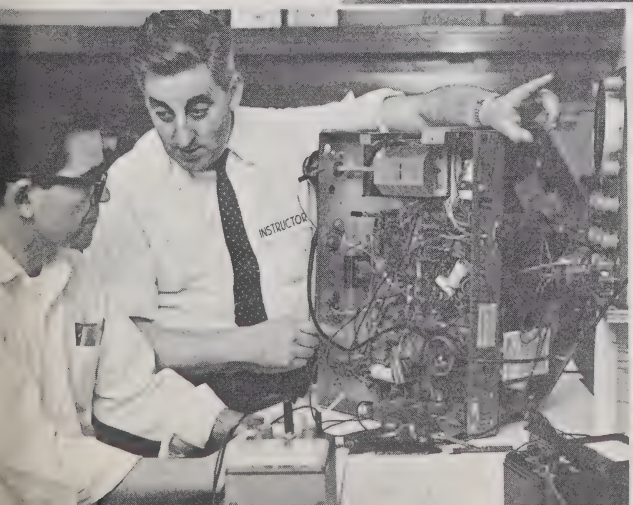
In addition to having the skills being taught, teachers and instructors must have a sincere desire to help people and the ability to impart their knowledge to others. Leadership—that indefinable quality which commands respect—is essential for the maintenance of classroom discipline. Other desirable qualities include a good appearance and a clear speaking voice.

For those interested in obtaining further information on teaching careers, the booklet TEACHER is available in this Series.

Students are taught machine shop practices in Vocational Schools



Many Canadian companies employ instructors in plant training programs



Instructors explain the practical application of theoretical studies in this provincial Institute of Trades

FIELDS OF WORK

Where do technicians work? Wherever there are scientific and technical activities technicians are there also, working in some important capacity. In fact, technicians are now so widely employed that it is possible only to include some of the many fields of work in a booklet of this size. Fields of work selected for inclusion are those for which courses are currently available in institutes of technology, or for which there are other clearly defined training routes.

ELECTRICAL TECHNOLOGY

Two main fields of employment are provided by electrical technology—power and electronics—but, within these fields, there are many divisions. For example, an electronic technician may work in one division, perhaps communications, but will specialize in a subdivision such as television or telephony.

Technicians in any division will find themselves using their theoretical training and practical skills in one or more functions described under *Nature of the Work*. However, their precise function will be governed by the division in which they may specialize, details of which follow.

In power generating stations and substations, technicians are assigned such duties as operation and load planning. Or they may test, inspect and maintain generators, motors, transformers, automatic controls and similar equipment.

In electrical manufacturing, technicians assist in the design and testing of electrical products which may range from massive power-station generators to small appliances for domestic households. They help solve problems connected with their company's products such as improving performance or size reduction; they supervise production processes and undertake non-routine testing and inspection.

In factories, hospitals, hotels and other large buildings, they supervise the installation of electrical systems; inspect these installations for conformity with local and federal Electrical Codes; and may undertake maintenance and repair work. Yet others are employed in such specialities as ultrasonics—a simple application of which is the cleaning of instruments—high-frequency heating, or the diathermy and X-ray apparatus of the medical field.

The broad field of electronics can be considered as that branch of electricity which makes use of components such as tubes and semi-conductors (transistors). In its more familiar uses, electronics is the basis for radio, television and other forms of communication. Other applications include those of industry, commerce and defence.

There are many areas of employment: equipment manufacturing; recording, measuring, controlling and indicating industrial processes; military and civil guidance and navigational systems and the many varieties of telecommunication. The recording of messages, statistics and inventories is becoming dependent on computing devices which, together with automatic controls (automation), are dependent on the electronic tube or semi-conductor. Not to be overlooked is the importance of electronics in other fields: the electronic cardioscope and microscope of medicine and science; the cyclotron and betatron of the atomic energy field; and the electronic telescope of astronomy.

The manufacturing industries undoubtedly offer the greatest number of employment opportunities in one of the major divisions: military and civil equipment; consumer products; electronic tubes and semi-conductors; and miscellaneous equipment.

Military and civil equipment manufacture includes instruments and equipment for guidance and detection systems, automatic controls and computing devices. Government departments make extensive use of this equipment; for example, electronic technicians are employed by the Department of National Defence in the maintenance and operation of the Distant Early Warning (D.E.W.) Line; by the Department of Transport to service and operate telecommunications systems and navigational systems such as radar, Loran and Instrument Landing (I.L.S.) for aircraft or shipping; and in many functions by the Armed Forces.

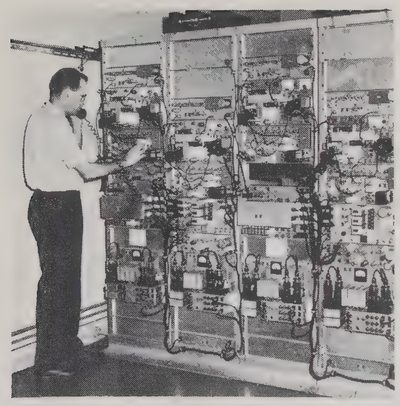
Consumer products include television, radio and high fidelity equipment and such appliances as hearing aids. Technicians are engaged in development, testing, supervision of manufacture and participate in the design of these products. Other major activities include the many functions required in the design and manufacture of tubes ranging from the radio receiving tube to those required for special purposes—the klystrons, magnetrons and cathode-ray tubes.

Modern industrial enterprises such as oil refineries, chemical plants, steel mills and paper mills have instrumentation installations, usually involving electronics for measurement, indication and control of various processes.

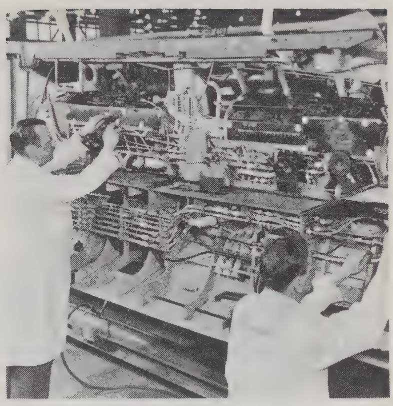
Many different combinations of theoretical knowledge and practical skills are required because of the wide variety of duties involved. Those engaged in assessing test requirements, planning test procedures and designing test apparatus require a high standard of knowledge in electrical and electronic theory. Testing and inspection work relies more heavily on practical skills in the use of such instruments as oscilloscopes, signal generators, ohmmeters, a.c. and d.c. bridges and high-voltage tests sets; sufficient theoretical knowledge is required to interpret, analyze and calculate test-set readings and recordings. Workers in repair and maintenance who are called technicians use handtools such as screwdrivers, wrenches, pliers and soldering irons and, as a general rule, use little mathematical and theoretical knowledge.

There are, however, certain characteristics all technicians must possess that are of vital importance in electrical power and electronics. These are a definite liking for study and a genuine interest in the field. Electrical technology is the most rapidly changing of all technologies. Most of the significant developments have been made within the past twenty years; the next ten years will see developments unforeseen at present. This means that technicians must be prepared to study and keep abreast of all the latest developments.

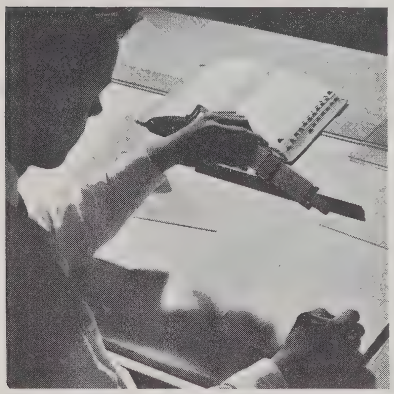
For those interested in obtaining more information on power generation, telecommunications and broadcasting, there is a booklet ELECTRICAL AND ELECTRONIC OCCUPATIONS in this Series.



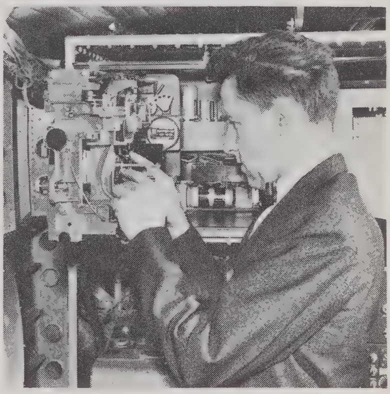
Microwave equipment under test



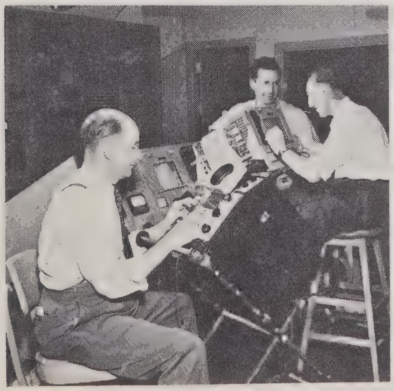
Installation of aircraft electrical systems



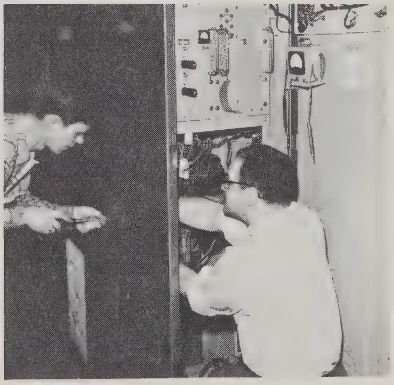
Design drafting is an important function



Military equipment must meet rigid standards



Diagnosing faults is another function of technicians



Assembly of television transmitter presents no problem to the well-trained technician

MECHANICAL TECHNOLOGY

Since virtually all industries use machines, mechanical technology underlies many different industrial operations and merges at some point with many other technologies. For example, mechanical technology provides mechanisms and equipment for electrical and civil engineering projects.

There are several main areas of specialization, the scope of each being so wide that technicians will specialize in one of the following sub-divisions.

Power-generating machines—steam, diesel and other internal combustion, tidal and wind power machines; hydraulic and gas turbines.

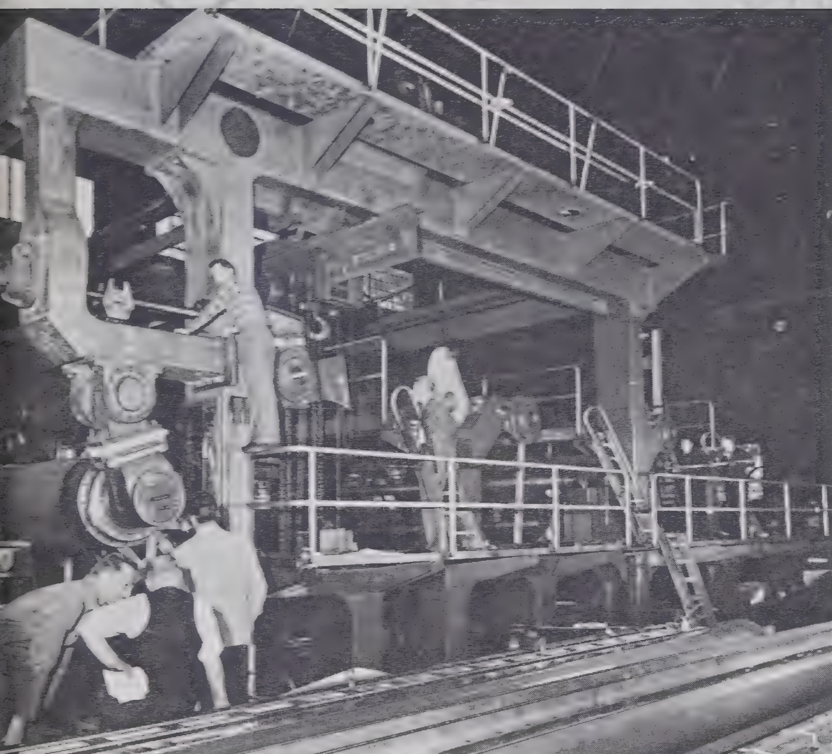
Power-transmission and material-handling equipment—conveyors, gears, shafting and heat transfer.

Power-using motors and bodies—machine tools, fans and other appliances; industrial furnaces; automobiles, locomotives, aircraft and marine vessels.

Air-conditioning—heating, ventilation and refrigeration.

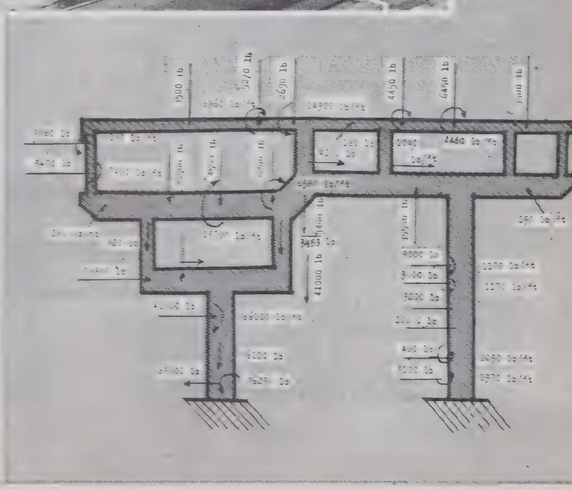
Technicians whose talents lie more in mechanical ingenuity and organizing ability are to be found as superintendents, installation foremen, production planners and detail analysts. Those with drafting ability translate design ideas into working drawings. Those with mathematical and scientific ability may be involved with technical problems related to gearing, lubrication, bearings, shapes and structures. Yet others are in maintenance, inspection and operation.

In addition to academic qualifications, the aspiring technician requires an inquisitive mind, not only to find out how a mechanism works but how to make it work better. Manual dexterity and the initiative to cope with unanticipated situations when they arise are decided advantages.



Typical of the many different functions in which technicians may be engaged is installation work such as the erection of the press frame shown above

Design of this press frame involved a number of rigid joints (depicted on the right). To match them all, a system of more than 100 mathematical equations had to be solved



AERONAUTICAL TECHNOLOGY

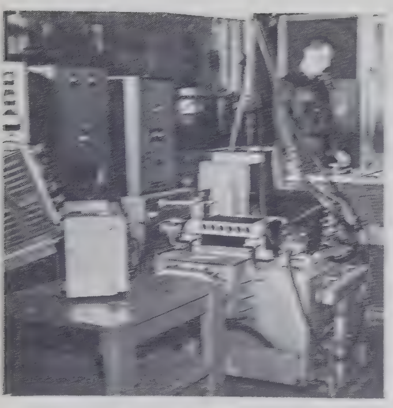
Well over two hundred different kinds of technicians are employed in the aeronautical field. A wide variety of duties is involved and it is possible to give only general outlines. There is a booklet, OCCUPATIONS IN THE AIRCRAFT MANUFACTURING INDUSTRY, which forms part of this Series.

Broad fields of work for technicians include research, design and development departments, manufacturing functions and airline operation.

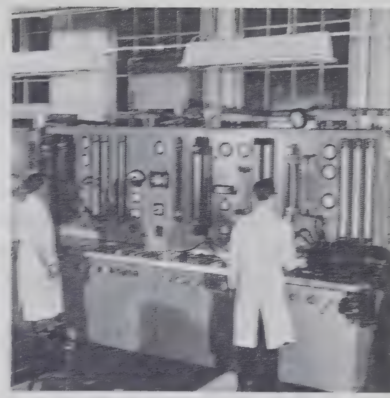
Research and development technicians are employed in the search for new materials, ways of improving speeds and payloads. Their work includes flight test evaluation, weight control and stress analyses. It also includes wind tunnel investigations into airflow around shapes, structural and vibration testing and the performance testing of engines and their components. Research work is being carried out in the field of space vehicles such as the *Black Brant* high-altitude research rocket and the *Alouette* satellite where technicians are assisting in experimentation and development.

Design and development technicians work in experimental departments, laboratories and design offices which are clean and well lighted. Noise is to be expected in wind tunnel work and in engine testing. Some technicians work at drawing boards and perform very few physical tasks: others, in engine test cells or in flight test programs, live very strenuous lives.

Manufacturing consists of many branches—engines, airframes, installation of equipment and systems, inspection and so on. Technicians assist with the application of engineering principles in solving design, development and modification problems. They prepare preliminary sketches and working drawings; act as liaison between engineering and production departments; and undertake quality control, production planning and tool design.



Functions carried out by technicians include environmental testing—freezing, heating, altitude, vibration, etc.

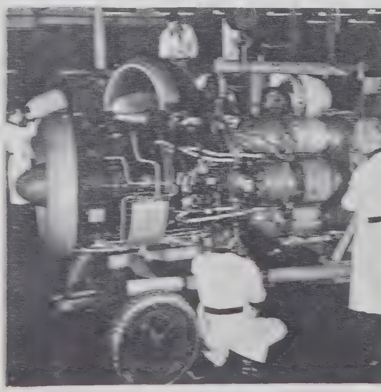


Types of equipment used in testing are depicted to the left and above

Space vehicles are assembled and tested by technicians

Flight models are stressed using strain gauges and similar devices

Components such as this heater valve actuator examined for defects



Jet engines are periodically serviced by technicians

Air transportation technicians are more concerned with the practical aspects of aircraft maintenance and with the operation of airport facilities such as direction-finding, landing and communications systems.

In maintenance work, technicians may be exposed to inclement weather and, since air transportation is on a round-the-clock basis, shifts and week-end work are to be expected.

Civil airlines operate under federal government regulations which require that those responsible for aircraft maintenance have special qualifications. Training for these qualifications can be obtained in institutes of technology. For example, a diploma from the Department of Aeronautical Technology, Southern Alberta Institute of Technology, is recognized as an exemption from most of the Department of Transport examinations for Aircraft Maintenance Engineers' Licences.

Aircraft maintenance engineers may be in positions ranging from superintendent to that of mechanic in the rebuilding, repair, overhaul and quality control departments of aircraft companies.

Most aircraft plants, hangars and laboratories are modern, clean, and well lighted buildings. Equipment, tools and materials are of the latest design as can be expected in a newer industry.

INSTRUMENTATION TECHNOLOGY

Technological changes in industry and business have led to the replacement of human judgment by automatic control. Continuous production methods, greater accuracy and reduced margins of error have become possible, due to the development of instruments which measure, indicate and control.

Types of instruments now in use are many and varied, embodying as they do electrical, mechanical, hydraulic, pneumatic and perhaps optical principles. Because of these many principles and the increasing complexity of industrial processes, instrument technicians require a thorough knowledge of mathematics, physics and sciences in many phases of instrumentation in addition to the techniques of instrument repair.

There are two main fields of employment. One is with firms who design, manufacture and sell engineering, laboratory, scientific and optical instruments; the other is in industries such as the chemical, petroleum refining, papermaking, electrical utility and the air transport fields. Smaller numbers of technicians are in meteorology, geophysics and similar scientific fields.

Occupations in instrumentation are still emerging and there is considerable overlap between instrumentation, mechanical, chemical and electrical technicians. Consequently, duties will vary from industry to industry, and from company to company within the same industry. In general, technicians develop, install, calibrate, trouble-shoot and repair instruments and control systems.

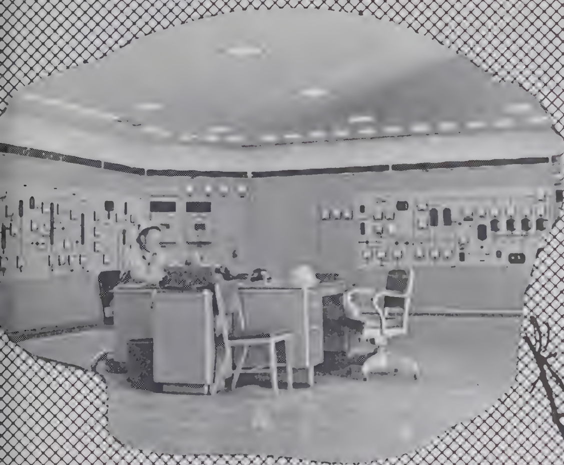
Routine functions, which can be undertaken without going into a theoretical analysis in each case, such as bench repair and servicing, are carried out by apprenticeship-trained technicians or mechanics. Graduates of institutes of technology are more likely to be employed in functions demanding theoretical knowledge. These could be the design functions of an instrument manufactur-

ing company, i.e., the mocking up and testing of new systems; preparation of circuit diagrams and component selection; layout of systems for a new industrial process; or obtaining and interpreting engineering and scientific data.

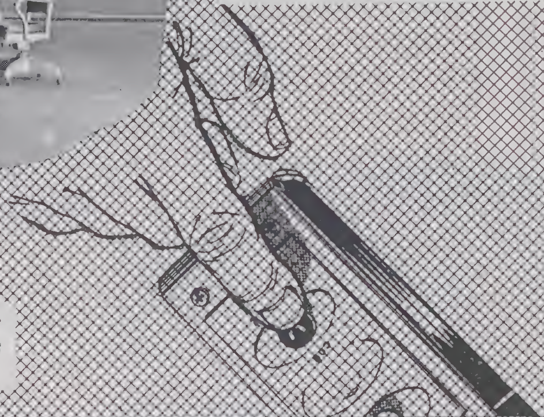
Alternatively, in industry, technicians may develop and install the instrumentation necessary to control a particular industrial process. To control a process, variables such as temperatures, densities, liquid flow and levels, pressures and relative humidities, have to be measured. Technicians, in conjunction with control engineers, prepare design drawings showing the most suitable components and systems. Then, primary elements are installed by tradesmen. Transmission lines—electrical, air, liquid and vacuum—are installed by technicians, coupled to controllers and tested for leaks and other defects. Scales and recording charts of the controllers are calibrated and, finally, the whole installation tested for correct operation.

The foregoing will indicate some of the many tasks of the instrument technicians. Their duties are changing rapidly, new problems are always arising and instrumentation is being applied to many new industrial processes. For these reasons, technicians must be alert to notice small details and must be able to grasp oral instructions easily and quickly.

Instrument technicians will meet a variety of working conditions. Those with instrument companies spend their time in the cleanliness and orderliness of engineering offices. Those working, for example, on pipeline instrumentation may be in isolated surroundings. Those in process control will have to work in plants and meet existing conditions of heat, dirt, dust and noise.



The Control Room of the Imperial Oil Refinery at Edmonton, Alberta where operators, through the use of instrumentation, control all refining units, indicator flow recorders, temperature gauges and pressure gauges



Information is provided to the operators by panoramic panels with diagrams

CHEMICAL TECHNOLOGY

Chemical technology is the application of laboratory processes to large-scale commercial manufacture and includes the design, construction and operation of plant and equipment. The use of chemical technology is widespread and continues to grow; for example, during the period 1958-60, investment capital in the Canadian chemical industry increased at a rate three times that of other manufacturing industries.

Technicians are employed in industries such as petroleum and its by-products, synthetic textiles, protective coatings, plastics, pharmaceuticals, insecticides, food processing, metals and minerals.

Functions of these technicians vary from research, development, plant operation and quality control to sales and service. More particularly, technicians undertake the following duties:

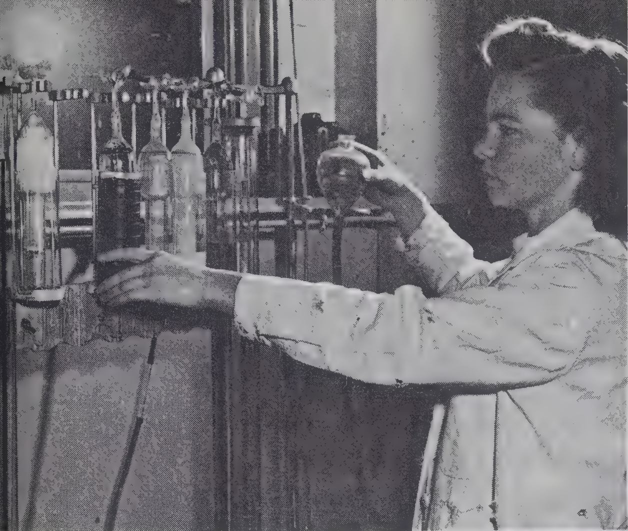
In research and industrial laboratories, they assemble and operate experimental equipment; use mathematical and chemical data to make calculations and measurements; and perform qualitative and quantitative analyses.

In process development, technicians may build small-scale plants to test a design before full-scale production is authorized. Where batches of different chemicals are made, they may work on new formulae and processes before they are put into production. Others perform quality control tests ranging from routine sampling to complex analyses.

In plant supervision, technicians are increasingly employed where a high degree of automatic control is being introduced.

Probably the most important personal qualities are those of mental curiosity and perseverance; for many laboratory operations, a liking for precise detail, and good eyesight is essential.

The conditions encountered in laboratories include fumes and odours although any danger is removed by adequate ventilation. Process and plant supervisors will be called on to work in an environment where conditions of heat, fumes and dust may be encountered.

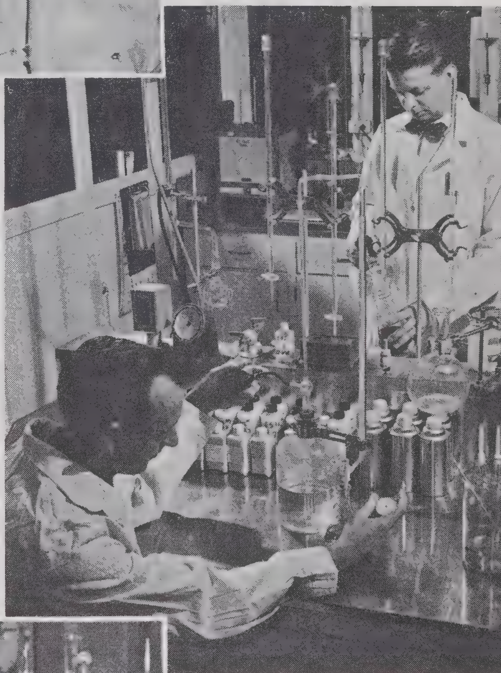


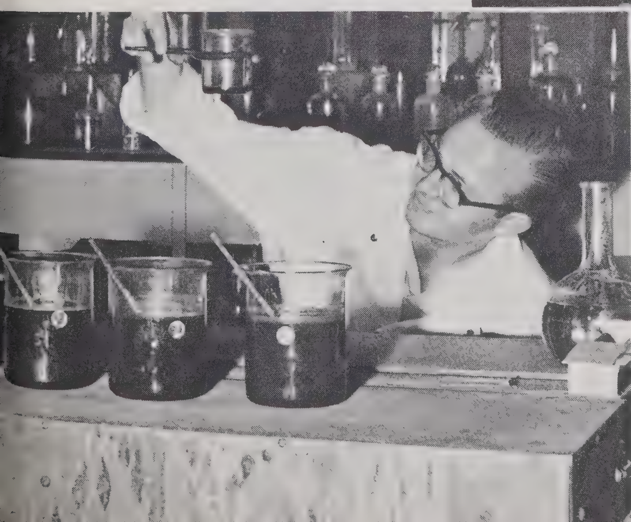
Chemistry underlies many industrial processes—virtually every industry employs chemical technicians

Above: An Orsat gas analysis apparatus used in the synthetic rubber industry

Centre: Cosmeticians experiment with hand lotions

Below: Research laboratory scene in a metallurgical laboratory





ARCHITECTURAL TECHNOLOGY

The rapid expansion which has taken place since World War II in the construction industry has led to the growth of many jobs for technicians. Architects, faced with the design of large buildings employ technicians in many functions which they would otherwise perform themselves.

In this technician group, the work depends on the activities carried out by the employer. Typical functions are given in the following paragraphs but often several of these are combined, depending on the size of the architect's business.

Architectural draftsmen prepare presentation drawings and scale models under the supervision of an architect. When the preliminary schemes are approved by the client, technicians incorporate any desired modifications and prepare actual working and detailed drawings to be used on the building site.

Drawings are sent out to contractors with invitations to tender and are supplemented by instructions written by specification writers. In the contractor's offices, estimators prepare cost analyses and quotations for submission to the clients.

At the final stage, that of construction, technicians work on the building site as clerks-of-works, foremen, inspectors, supervisors and material planners.

Employment is found with architectural offices and consulting engineers; in similar positions with the architectural departments of federal, provincial and municipal governments; with real estate, building contracting, commercial and industrial concerns; and with town planning, landscape and similar consultants.

Architecture is the fine art of creating buildings of beauty and, for this reason, architects and their assistants must have an interest in the arts and a marked talent for drawing. They need a creative and original turn of mind, imagination and the power of visualization. To these must be added a practical outlook; decisions as to

which methods and materials to use within certain cost limitations, demand a practical as well as an artistic frame of mind. Since the architect's success depends, not only on ability, but also on personal service, technicians with pleasant, tactful and forceful personalities can add a great deal to this success.

Architects' offices, designed not only as working areas but also for the reception of clients, are clean, well lighted and usually air-conditioned buildings. Technicians employed on building sites will encounter seasonal weather conditions and reasonably good health is necessary.

CIVIL TECHNOLOGY

Design and construction of stationary structures, planning and zoning, and the surveying and reconstruction of geographical features of the earth, is a simple definition of civil technology. For technicians this is a very broad field of work and overlaps with many other technologies. Civil technicians, for example, work with electrical technicians in the construction of electrical power generating stations or with chemical technicians in the laying of gas and oil pipeline systems.

Within civil technology, there are four main fields of work, each with many subdivisions:

Transportation—highways, streets, railroads, viaducts, airports, bridges, tunnels and subways.

Structural—bridges, tunnels, subways, large buildings and electrical transmission towers.

Hydraulic—dams, flood control, irrigation systems, harbours, canals and tunnels.

Sanitary—reservoirs, drainage and sewage disposal systems, and pollution control.

Typical technician functions in these subdivisions include the following:

Assisting city engineers in the design and layout of streets, sewers, water mains and other facilities; or in planning, zoning and traffic studies necessary for efficient city maintenance.

Drafting detailed drawings and plans for structural steel and reinforced buildings, roads, bridges and other rights-of-way.

Estimating amounts and costs of materials, supplies and labour for construction projects.

Supervising construction projects; inpecting grades, forms, materials and construction methods.

Determining co-ordinates for geographical positions, land lines and land monuments (under the direction of a licenced land surveyor).

Surveying—the establishment of elevation and positions for road and engineering construction—is a separate and distinct field of work although practised as an important part of civil technology. Institute of technology courses are available in surveying with a stated two-fold purpose: to provide the practical skills and knowledge of surveying to earn a living directly on entering this field; and to prepare students for the professional examinations of the Dominion or Provincial Land Surveyors' Associations.

In addition to surveying opportunities in civil technology, there are also opportunities with oil and gas companies, consulting engineers and provincial or federal government departments, such as the surveying and mapping branches.

Many civil technicians are employed in outdoor duties, and possibly in isolated and rugged districts. In consequence, a good physique is necessary to cope with adverse weather conditions. Civil technicians should be inquisitive, have analytical ability and interest in detail, since many positions require such qualities. Although they are expected to follow directions accurately, they should have sufficient initiative to meet difficult and unexpected situations which will arise from time to time.

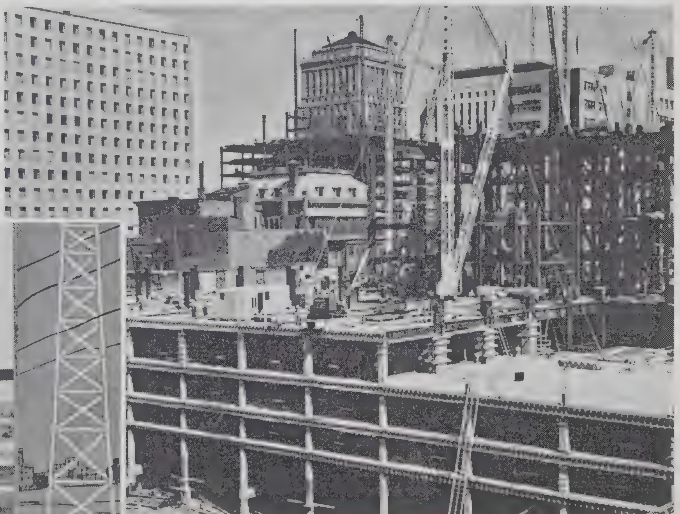
lbove: Topographical drafting

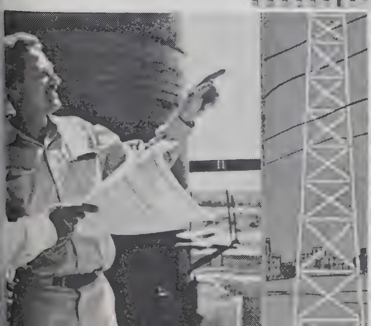
Jpper right: Surveying

Typical technician functions in civil technology include the following. There are many other supporting but equally important functions

bove: Clerk-of-Works

elow: Supervisor and foreman





AGRICULTURE

A century ago, farms were largely self-supporting and independent of other segments of the community. Today, the situation is very different; the farmer, generally, is dependent on other technologies for machinery, chemicals, ready-mix feeds and on utilities such as electric power.

Many other changes are taking place. Farms are greater in size or intensity, more specialized, and require more capital for their operation. Canada is one of the world's largest exporters of food products, but this market is increasingly competitive. To meet this challenge, and that of feeding a growing population, farming has become a complex industry whose future will depend on the success with which advances in biology, chemistry, engineering, physics or economics can be incorporated into farming to increase productivity and thus reduce costs.

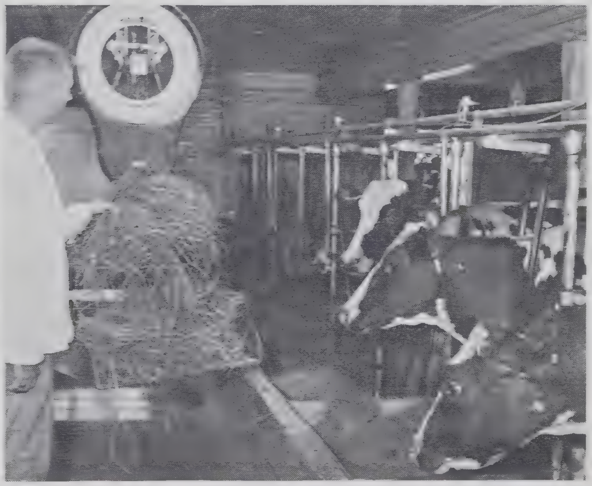
In the face of these changes, a realignment is taking place in agriculture and fewer but more highly skilled workers are now employed. The need is also being felt for specialists in one or more branches of agricultural technology—an intermediate person between the professional agrologist and the agricultural worker—and who may be considered as the agricultural technician.

At the present time, most of the tasks which come within the scope of the technician have been assumed by the agrologist. However, technicians are employed as research assistants and laboratory aides, primarily in government departments. Others undertake performance tests, grading and inspection duties and act as grain buyers or information officers.

Diploma courses in agriculture, usually of two years' duration, are currently available in eight provinces. Active steps are now being taken to provide training of a more highly specialized nature. Significant is the recent setting up at Ste. Anne de la Pocatière of post-secondary school courses the graduates of which will be awarded a diploma in technical studies in agriculture. This diploma will probably provide the entrance requirement to membership of the Corporation of Professional Technicians of the Province of Quebec.

Twenty years ago, an agricultural worker supplied enough food for himself and nine other persons. Today he produces enough for 22 other persons. This increased output is the result of skills, knowledge and resourcefulness of many workers including technicians. Here are a few examples of the technician's contributions

chnicians work in basic research



ey undertake nutritional tests to velop better feeding practices d better quality feeds

And apply their engineering and technical knowledge to the development of mechanized equipment

It is expected that when more specialized training becomes available, technicians will staff public and private farm services and fill many positions in business and industry serving agriculture. Knowing the most efficient engineering techniques they could advise on the best use of power equipment; knowing the chemistry of soils, fertilizers and insecticides they could advise on their use; and could advise on new plants and animals or the latest methods of grading and packaging.

FOOD PROCESSING

The technology of food processing, simply defined, can be considered as the industrial preparation and preservation of edible products.

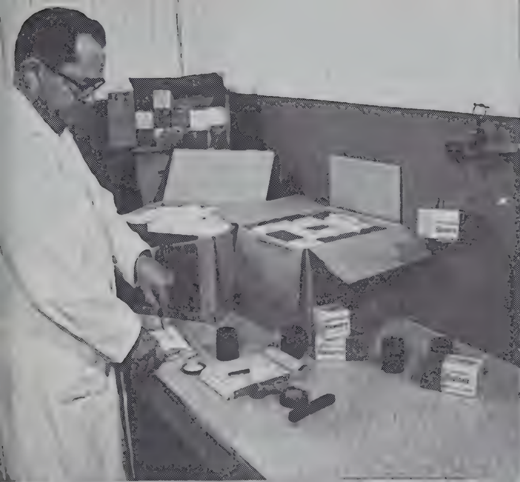
Methods of preparation include such processes as drying, salting, cooling, heating, fermenting, cooking and packaging. Many technical advances have been made in recent years in the food processing industries and freeze drying, dehydro-freezing and nuclear irradiation may soon become common practices.

Employment opportunities include those with companies which prepare fish, meat and dairy products; fruit and vegetable canneries and processors; grain and feed processors; beverage makers; and makers of specialty products.

Processes, machinery and equipment used in the food processing industry are increasing in complexity. In consequence, an increasing number of functions are demanding people with specialized skills and technical training.

These functions include the control and operation of the specialized equipment or processes within the plant itself; or the testing of raw materials, materials in process or the finished product for such qualities as uniformity, purity and acceptability.

In research laboratories, technically trained personnel assist in chemical, physical and bacteriological tests or help to develop new processes. Other functions requiring specialized training include instrumentation; the development of new or improved machinery and methods of automatic packaging; quality control; and business management such as time-and-motion studies, cost control and production planning.



esting and inspection are important functions food processing

bove: Test samples are taken from each batch of butter

entre: Sugar juice is analyzed for quality

elow: Meat is graded

FOREST TECHNOLOGY

Forest technology is the scientific management and conservation of the forested areas which constitute a great part of our natural resources.

Some of the problems connected with forest technology include the study of how trees grow, where a particular species will grow best, how to ensure that continuous crops can be harvested and how to make accurate inventories of timber.

There is some degree of overlap with other technologies. Civil technicians are concerned with the problems of transportation—construction of forest roads or improvement of waterways—and mechanical technicians are concerned with mechanized handling equipment. Associated fields include wildlife management and fire prevention.

Forest technicians are employed by industrial concerns such as pulp and paper mills, primarily in Eastern Canada, and by lumber companies in the west. University-trained forestry engineers, responsible for overall control, are supported by technicians in many detailed aspects of their work. In forming the bridge between woods workers and engineers, technicians are employed in a variety of duties such as:

Timber cruising—taking inventories of forested areas.

Photo interpretation (photogrammetry)—extracting information from aerial photographs for use in surveying, inventory and road building.

Compilation work—examination of data collected in cruising to prepare forest information.

Cutting supervision—layout of areas to be harvested; blazing boundaries; marking trees; and ensuring that company and government regulations are observed.

Research work—establishing experimental areas for observation of growth rates, regeneration, pest and disease damage and the many other factors which affect a forest.

In addition to adequate training, qualifications for success in forestry include the ability to meet and deal effectively with people. Many jobs also require the ability to endure vigorous physical activity, and the willingness to work in isolated areas.

bove:

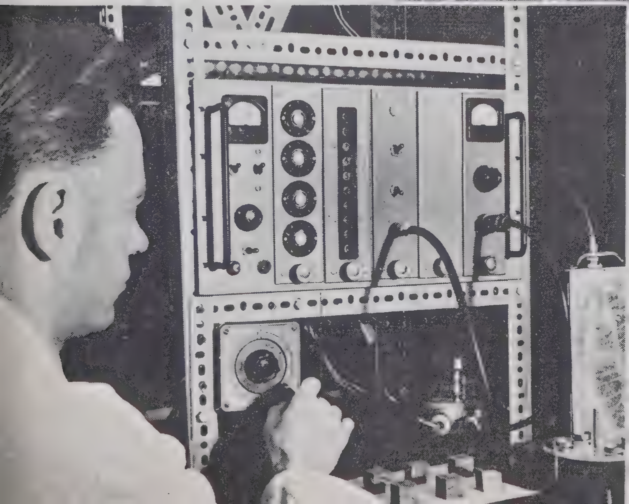
laboratory technician prepares for icroscopic examination of wood-estroying fungi

entre:

nstallation of equipment to measure oil temperatures

elow:

Vood preservative is examined with he help of radio-active counters by his research technician



PAPERMAKING TECHNOLOGY

The manufacture of pulp and paper has been Canada's leading industry for many years. It stands first among all industries in value of production, exports and total wages paid.

Papermaking technology comprises three fields of work:

Conversion—primarily of wood into pulp.

Processing—of pulp into paper and paperboard.

Manufacture—of paper and paperboard into many different products such as paper bags, boxes and coated printing papers.

The increasing complexity of pulp and paper manufacturing, including mass production and large-scale output, has led to the employment of technicians with chemical, electrical, instrumentation and other scientific training.

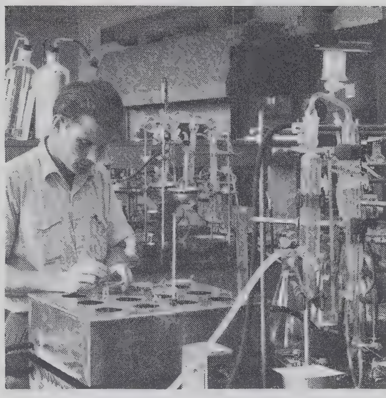
Laboratory technicians are employed in basic research into the chemistry of woods; chemical and mechanical pulping processes; bleaching and colouring; testing of materials to be added to pulp; fibre modification; stream and air pollution; and in chemical testing.

Other technicians apply their knowledge of mechanical technology to design, construction and operation problems and to the improvement of pulp and papermaking equipment. Yet others are engaged in the adaption of laboratory processes into large-scale production.

Throughout the manufacture of pulp, paper and allied products, frequent testing is carried out to determine weight, strength, colour, finish and size. Some of this work is done by machine operators but laboratory technicians, pulp testers and paper testers are employed in many mills. Tests may range from routine checks to highly-complex analyses. Other technicians in the papermaking and allied fields such as chemical and instrumentation technicians, are described in other sections of this booklet.

There is considerable variety in working conditions. Some technicians work in areas which are hot, humid and noisy. They are also exposed to odours from the chemicals used in papermaking processes. Pulp and paper companies, however, make intensive efforts to reduce heat and odours to the minimum by adequate ventilation.

Trees are measured and weighed at logging sites

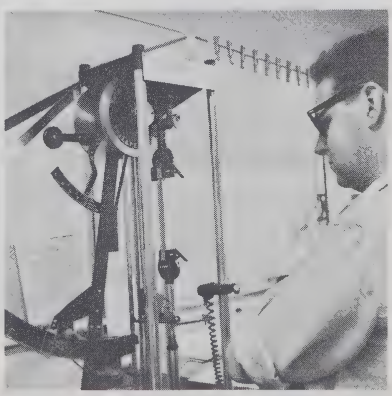


Chemical analyses are undertaken in the laboratory

New processes are tested in this pilot plant

Tests are made of the chemicals used in the making of paper

Pulp is made by hand into sheets which will be tested for strength



Paper is tested for quality, strength, resistance and whiteness

PRINTING TECHNOLOGY

Printing may be considered a universal technology for there is hardly any aspect of our daily lives which is not affected by printed material.

Four million newspapers are printed in Canada daily to keep the nation informed. Every industry, office and store uses an endless variety of forms, charts and letterheads to control processes and to keep records, while virtually every enterprise uses printed material to display or sell its products. Annually, forty million dollars worth of books, periodicals, magazines and catalogues are printed to educate, inform and entertain the reading public.

To supply this demand, Canada has over 2,800 printing firms employing a total of 31,000 people and ranging in size from small, owner-operated shops to large establishments with several hundred employees.

Many different talents are used in the printing industry. Typically artistic ability is required to design and produce illustrations, covers and layouts, or the engraving of plates and the production of photographic copy. Mechanical ability is used in the operation of presses and other printing machines while literary ability is needed in copy writing and editorial work.

There are also many other functions, estimation, production planning and inventory control, for example, which require a knowledge of mathematics and printing processes. These functions are undertaken by personnel who, for ease of understanding, can be considered under the general title of printing administrative technicians.

Printing administrative technicians are employed either in one specific function or in a combination of the following functions, depending on the size of the printing establishment in which they are employed.

For each printing job, they specify, calculate and order inks, papers, plates and other supplies; decide which printing process is to be used; measure and scale copy; estimate time factors and costs of production; and may prepare cost quotations.

For each printing job inks, paper, plates and other supplies must be calculated; the most suitable printing process decided; and cost estimates prepared

To perform these functions, they require a thorough knowledge of materials and the terminology involved; sources of supply; purchasing procedures; the kinds of records to keep and similar information.

Unlike craftsmen, they are not required to operate printing equipment; however, they must understand its operating principles, capacities, speeds and the ranges of quality to be expected.

To estimate, to interpret and to make accurate calculations, the technicians use tools, of which the slide rule is probably the most important, together with charts, scales, complex mathematical tables and standards such as those issued by the Printing Industry of America—*PAR Tables, Estimating and Printing Production Management*.

MINING TECHNOLOGY

Minerals, one of Canada's main sources of natural wealth, is exceeded in value only by forestry and agricultural products. Mining technology is the extraction of this wealth from the earth which includes:

Metallic ores of—iron, lead, zinc, silver, uranium, copper, nickel, gold and cobalt.

Non-metallic ores such as—asbestos, gypsum, fluorspar and silica.

Structural materials—gravel, stone and clay.

Fuels—coal, petroleum and natural gas.

During recent years petroleum and its derivatives, and natural gas, have become so important that they have emerged as separate technologies, with courses available in institutes of technology.

The broad field of mining includes exploration, development, surface and underground operations, milling and other primary treatments, and mine-to-market operations. Of the many different activities, here are some of the main fields:

Exploration—Technicians are engaged in geophysical and geochemical surveys, mapping and claim staking. They are also engaged in diamond drilling, logging of diamond-drilled cores, sampling and establishing ore limits.

Mine and survey office—Many technicians divide their time between the mine and the engineering office. They employ survey instruments to mark-up mine development; provide grade and direction lines for miners; establish survey baselines; prepare maps of mine development progress; calculate the tons broken; calculate ore reserves; calculate contract payments; and undertake studies of method and equipment performance.

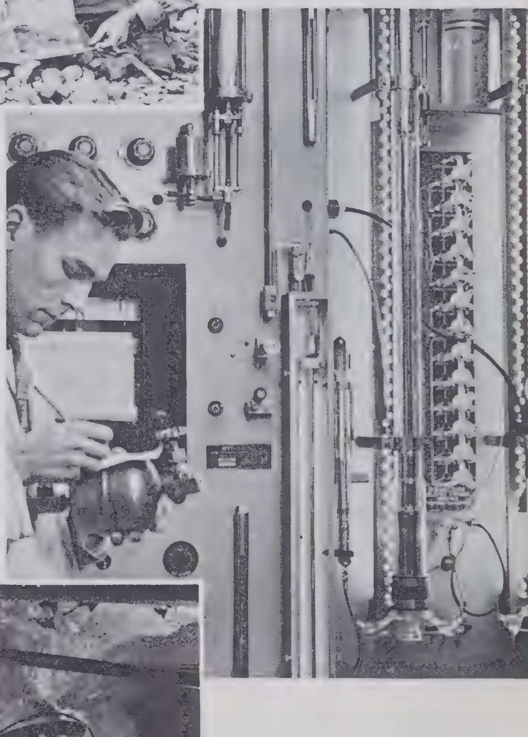
Laboratory work—In the laboratory, technicians assay mine, mill or prospectors' samples; make routine analyses of mill feed, concentrates and smelter samples. Alternatively they perform tests to control and improve processes and increase recovery.

Supervision—After they have acquired sufficient experience, technicians may become production supervisors. They will then supervise groups of miners; help train new workers; teach safety principles and lead safety programs; and schedule materials, supplies and labour. Occupations in mine supervision may lead to management positions.

Research—In recent years there has been a new awareness of the need for more research in mining practice. Extensive laboratories have been established by some of the larger mining companies, by the Government of Canada, and by some provincial governments. Technicians may assist scientists in studies related to ground pressure, methods of support, and new ways of doing operations incidental to mining. Not all research is undertaken in laboratories; methods in use can be studied in the mines.

For those interested in obtaining more detailed information on this technology, there is a booklet MINING OCCUPATIONS in this Series.

Geological survey parties undertake exploration in Canada's far North



A chemical technician tests gaseous samples from a refinery gas recovery unit

Survey instruments are used to provide lines for miners

Petroleum

With the discovery and exploitation of oil deposits in Western Canada, petroleum technology has become an area requiring specialized personnel. There are two main kinds of technician—those involved in exploration assisting geologists and geophysicists, and those involved in the actual production and preparation of oil and gas for markets. Courses at institutes of technology are designed so that graduates can enter either of these branches.

Extraction of oil from the earth is in three main stages—exploration, drilling and production.

Exploration is undertaken by small, specialized crews under the direction of geologists or geophysicists. They study the composition of the earth and undertake seismic and gravimetric surveys. Technicians in these crews include draftsmen, computers, plane tablemen and the operators of electrical and other measurement devices.

Drilling of likely sites is then undertaken to determine whether oil is actually present. Technicians, under the direction of petroleum engineers, supervise and assist in drilling operations.

Some technicians work in the district offices of oil companies and exploration firms where they interpret data collected by field crews. Most of them, however, spend a great deal of their time making field surveys often in rough and isolated sections of the country.

Most oil field work is outdoors and a sturdy constitution is needed as workers are exposed to extremes of weather. Drilling crews may expect to remain in one district for a year or so at the most; exploration personnel move even more frequently.

Crude oil as produced from the ground has very few uses. It must be transported to refining centres, usually by pipeline systems, where it goes through a manufacturing process known as refining. Natural gas is also transported by pipeline and requires treatment. Hence employment opportunities are provided for technicians with similar training in gas processing plants and gas transmission companies.

A sizable petrochemical industry has now made an appearance and offers career prospects for graduates from industrial laboratory and chemical technology courses.

Natural Gas

The industrial progress of any nation depends almost entirely on abundant and dependable sources of reasonably priced energy. Canada is extremely fortunate in having virtually unlimited reserves of natural gas in the western provinces. Exploitation of these reserves is currently in a period of great expansion. In 1960, eight per cent of Canada's total energy was supplied by natural gas. It is projected that, by 1980, this figure will reach twenty-five per cent.

Vast amounts of money are now being spent by utility companies in gas transmission and distribution systems and metering stations, and by manufacturers of industrial and domestic gas consuming equipment. This is resulting in the growth of many functions requiring mathematical and scientific skills and a knowledge of complex techniques. Typical of these are the following:

Design—Drafting of pipeline networks, distribution systems, regulating stations and metering installations; design of domestic and industrial equipment; research into such problems as corrosion.

Development—Studies of comparative fuel costs for industrial use; estimates and proposals for industrial users; selection of equipment combinations with ovens, furnaces, kilns and boilers.

Construction—Cost estimation; inspection; control of contracts; and location surveys.

Operation—Preparation of load studies; load dispatching and controlling; supervision and maintenance of control systems; and the operation and supervision of industrial and commercial gas burning and utilizing systems.

METALLURGICAL TECHNOLOGY

Metallurgy has been an important factor in the Canadian economy for many years. Today, Canada stands high among the world's leading producers of many metals including nickel, gold, zinc, silver, copper, lead, iron and uranium.

Metallurgical technology consists of two main branches. The first of these, extractive metallurgy, deals with the extraction of metals from their ores and with refining and related processes. The other branch, physical metallurgy, deals with the properties and structure of metals and their alloys, with methods of converting them into finished products, and their correct application in engineering structures.

The emphasis upon processing in Canada of the country's mineral wealth and its conversion into products, has led to the growth of many technician occupations in such industries as steel mills, foundries, metal-fabricating plants, automobile factories, pipeline companies and engine manufacturers.

Technicians in these industries assist in the following functions:

Research—Examination and testing metals and their ores; preparation of samples; development of improved alloys; collection and preparation of statistical data.

Metallography—Microscopic study of metals and their alloys.

Spectrography—Analysis of metals.

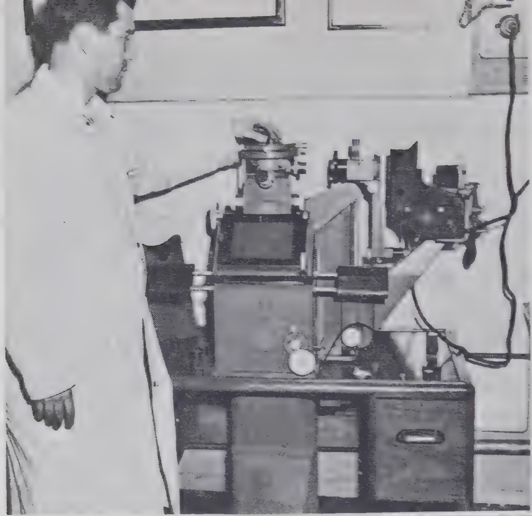
Heat treatment—Specification of procedures for hardening, tempering, annealing and other heat treatments.

Metal finishing—Specification of protective treatments and coatings.

Metal fabrication—Welding, casting, rolling, forming and forging operations.

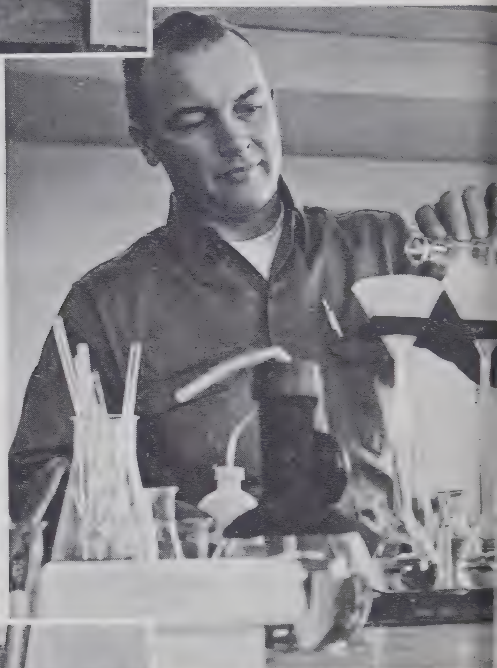
Inspection—Determination of internal flaws by X-ray and similar methods; batch inspection tests during refining processes; tests of welds; and tests for physical properties.

Plant operation—Determination of raw materials to be fed into melting furnace and smelters, and the supervision of processes.



Examination of the structure metals using a metallurgical m croscope in the research labor tories of Dominion Engineeri Limited

Chemical tests for phosphorus of an alloyed metal



Testing the high temperature pr erties of sand samples in a di ometer

Working conditions will depend on the industry and, to some extent on the age of the plant. Rolling mills are hot and noisy; foundries may require exposure to heat and dirt; and technicians, near blast and steel furnaces, are exposed to considerable heat. Laboratories, inspection and supervision offices and some departments such as maintenance are clean, air-conditioned buildings.

ATOMIC ENERGY

The relatively new and growing field of atomic energy employs technicians in a number of challenging positions, primarily in basic and applied research and in the design and development of materials and equipment.

Although the field is a wide one, the many activities may be considered in three main areas: mining technology; manufacture of nuclear fuels, reactors and components (including research equipment); and the operation and maintenance of reactors.

Mining and milling of uranium-bearing ores and the refining of ores is the responsibility of Eldorado Mining and Refining Limited, a crown company with a dual role as a producer of uranium and as the government agency for the purchase of uranium mined by private companies. (The field of Mining Technology is described on page 52.)

Atomic Energy of Canada Limited, also a crown company, is concerned with the design and development of power reactors and associated equipment. Divisions of this company are also involved in the development of nuclear fuels, the production of cobalt-60 beam therapy units and other devices using radioisotopes, physics, radio and radiation-chemistry, solid-state physics and many other areas involving neutron beams and radiation.

These programs are, for the most part, carried out by scientists and engineers. Technicians are engaged in important supporting roles, of which the following are typical. There are also many secondary but none-the-less vital functions which contribute to the success of research programs.

Mathematical computations to validate designs.

Preparation of detailed drawings from design specifications.

Assembling, testing, modifying and operating laboratory models and experimenting equipment; or making special components for use in experimental or pilot work.

Fabrication and installation of electrical, electronic and instrument systems and components.

At the present time, Atomic Energy of Canada Limited (AECL) is the largest single employer of technicians; however, private industry is becoming increasingly active in many phases. The Canadian General Electric Company Limited (CGE) and AMF Canada Limited are contractors for fuel element fabrication. CGE is also the main contractor for the construction of the Nuclear Power Demonstration (NPD) station, a joint project with the Hydro-Electric Power Commission of Ontario and AECL, now being commissioned at Rolphton, Ontario.

The Hydro Commission and AECL are partners in Canada's first full-scale nuclear power-generating station (CANDU—Canadian Deutrium-Uranium) at Douglas Point on the eastern shore of Lake Huron. Scheduled for operation in 1965, this station will have an output of 200,000 kilowatts. It is expected that when details of design, fabrication and assembly have been completed and operating techniques established, an increasing number of technicians will be employed in operation functions.

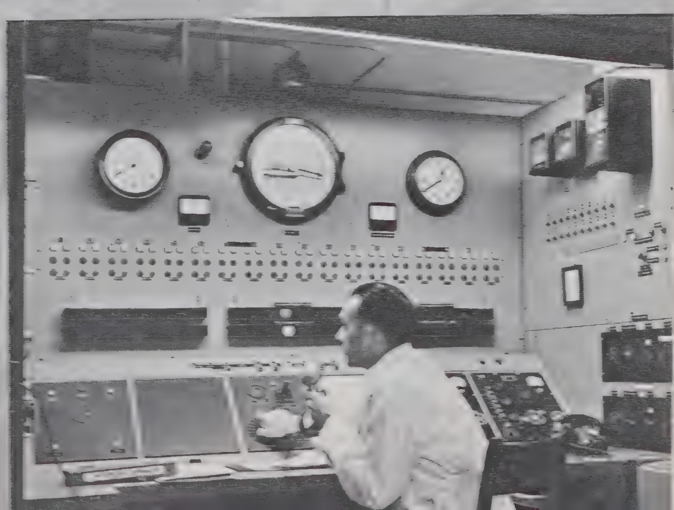
In its application to power generation, the nuclear reactor replaces the boiler of the conventional coal or oil burning station. Introduction of nuclear stations is therefore related to the availability and cost of conventional fuels and of water resources.

In the Western provinces, owing to cheap and abundant supplies of coal, oil and the untapped water resources, it is not expected that there will be nuclear power developments in the near future. However, in Ontario where most of the desirable water resources are now harnessed, nuclear power stations are being established.

Operation and maintenance of nuclear stations will probably be undertaken by Power Commissions and similar public utility companies. The number of technicians required in these functions is expected to be greater at least in the earlier stages, than conventional fuel-burning stations. This is expected partly because relatively little experience has yet been acquired and partly because of the safety precautions which are necessary.

Protective clothing is worn when handling plutonium alloy in the research laboratory of Atomic Energy of Canada Limited

The Control Panel from which the N.R.X. Reactor at Chalk River, Ontario is operated



TEXTILE TECHNOLOGY

Textiles, the industry which pioneered the industrial revolution some 200 years ago, has a long history of technical change and development. Today, because of the assimilation of the newer fibres into production and the intricacy of machines and processes, it is one of the most complex of all industrial undertakings.

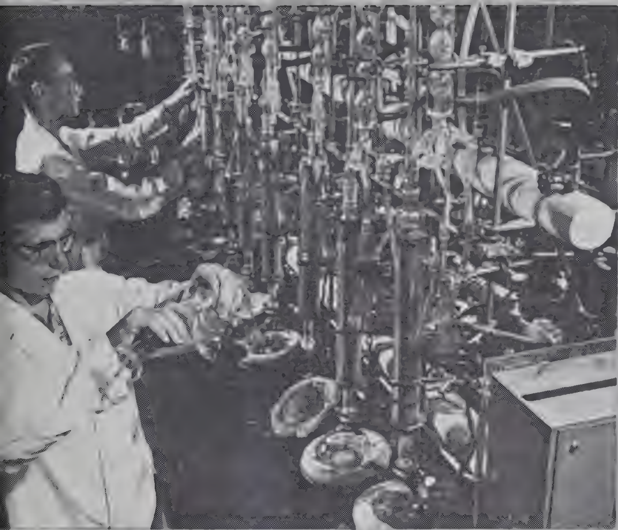
While most of Canada's textile mills, with their 80,000 employees, are concentrated in the industrial centres of Quebec and Ontario, the industry reaches from coast to coast. Producers of primary textiles include those companies which produce fibres and yarns and which convert these into woven, knitted, braided and coated fabrics for apparel uses, household furnishings, industrial uses, carpets and so on; knitted apparel; and others which dye and finish yarns and fabrics. The companies vary in size; some specialize in a narrow field such as spinning while others are highly integrated.

Such a complex industry requires the services of personnel trained in mathematics, chemistry and mechanics, with particular emphasis on their application to textile technology.

Employment openings are varied. Companies which produce fibres such as viscose, nylon, terylene, dynel, saran and orlon employ technicians with chemical training in their research and development departments. They are concerned with the problems of colour treatments, finishes and blends.

Others are employed with chemical and dyestuff manufacturing companies for development, testing and sales and service positions. Technicians trained in mechanical technology may work for textile machinery companies in the development of new techniques and equipment for such processes as spinning, warp preparation, winding, throwing, knitting and weaving.

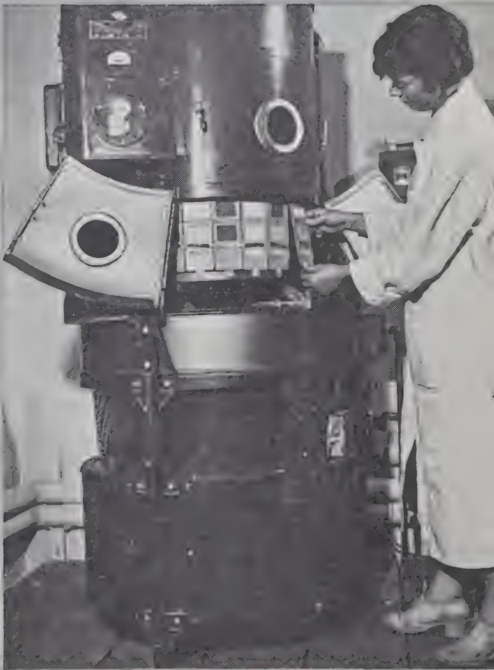
As may be expected in a highly mechanized industry, there are the important functions of production planning and control, time-and-method study and cost estimation. These functions require a good background in mathematics together with knowledge of the



Functions of technicians in the textile industry range from basic research into new fibres, through many intermediate stages, to the testing of the final product

Above:
Research into the chemistry of new fibres

Right:
Measuring the fading effects of sunlight on dyed textiles with a Fade-orometer



principles of machine operation. Complex mathematical calculations have to be made and a variety of charts and records kept to ensure that machines and labour are put to the most economical use.

The industry pays great attention to quality control and employs a high proportion of technicians in the functions of quality control, inspection and testing. Other occupations requiring a high standard of technical training include those of textile designing, sales, buying and supervision.

The mills are nearly all modern, well-lighted and air-conditioned. They are usually located in smaller centres—more than half are in communities with less than 25,000 population—and are often the hub of social life and recreation.

When considering training routes to employment in the textile industry, there is an important fact to note. Graduates from institutes of technology meet the educational requirements for Licentiate of the Textile Institute (Lic. T.I.). Further professional improvement and experience will qualify the Licentiate for Associateship (A.T.I.) which is recognized in the industry as the qualification for management careers.

PREPARATION AND TRAINING

What are the educational and other training requirements for technicians? So varied are the tasks of technicians that it is not surprising their education and training can be obtained in many different ways. Minimum educational requirements will vary with the technology, the industry and the specific job in which the technician is engaged. It must also be pointed out that formal training schemes, such as those of the institutes of technology, provide theoretical knowledge combined with laboratory and workshop practice in complex techniques: however, as in all work of a scientific or technical nature, considerable further practical experience is necessary to become fully competent. This is acquired on the job after taking up employment and may extend over several years, depending on the complexity of the functions involved.

Graduation from an institute of technology is advocated by educational authorities, professional associations and many employers as the most suitable route to technician positions. This is especially true for positions which demand a high standard in mathematics and sciences—and most technical work in the future will make these demands. Here are a few of the many reasons why this particular route is advocated.

Many changes are taking place in industry—the new products, techniques and developments which have already been mentioned. It is expected that these changes will be even more rapid and dramatic in the years ahead.

When considering training routes, it is important to know what these changes can mean in a working lifetime. In a changing world, graduates from these institutes are at a decided advantage compared with technicians whose training has been limited, perhaps to some specific skill. Graduates, because of the theoretical knowledge gained at these institutes, are better able to adjust to changing conditions; and since they have recognized qualifications they have better opportunities for advancement. Furthermore, as technical occupations are becoming better established and more clearly defined, educational requirements are rising and a more formal type of education is being demanded.

Other training routes include: pre-employment education and training in vocational and technical high schools, followed by on-the-job training; apprenticeship schemes or in-plant training courses given by employers. These training routes may have to be supplemented by part-time, evening or home study courses.

Not all technicians have had specific training. Some workers have become technicians through private studies and on-the-job training only, while others may have had some university education.

INSTITUTES OF TECHNOLOGY

Institutes of technology offer one, two- and three-year courses after high school; three years is the usual period. Some institutes (especially in the Province of Quebec) offer a fourth year of advanced studies. Entry requirements range from grade 10 to high school graduation, depending on the province and the technology; however, most of these courses are keyed to high school graduation. High school students intending to proceed to institutes of technology should examine the educational standards required for entry into a particular institute.

Both day and evening classes are offered at most institutes; some also provide correspondence courses. Evening and correspondence tuition is of particular value to those who must have a full-time job and is also used by employed workers who wish to upgrade their knowledge.

Since technicians are primarily concerned with the application of established principles rather than the discovery of those principles, the institute programs are a combination of theoretical studies and practical training. About half of their time is spent in laboratories and workships, testing and applying the theories taught in the classroom.

Typical theoretical studies include the following:

Mathematics (advanced algebra, geometry and calculus, etc.)

Field of specialty (chemistry, physics, electricity, forestry, mining, architecture, textiles, etc.)

Related technical subjects

Communications (language composition and report writing)

Economics and social studies (depending on the technology)

Annual fees range from $60 to $250, depending on the institute and the technology. Additional expenses for such items as books and instruments cost a further $20 to $100, although most institutes operate second-hand stores. In the Province of Quebec, tuition and book costs are borne by the provincial government; consequently, no fees are charged to students residing in the province. To the foregoing must be added the cost of accommodation for those students living away from home; one institute quotes from $15 to $20 per week for room and two meals.

It must be pointed out that most courses of instruction in the institutes are terminal in nature, i.e., designed to prepare students for immediate employment on graduation rather than proceed to higher education, although a few graduates do so. Under certain conditions, graduation from an institute of technology (Province of Quebec) enables admission to colleges. Students who complete an architectural course may receive an allowance of two years towards their five years of articleship. By writing the required examinations, graduates in chemistry may qualify for full membership of The Chemical Institute of Canada. In the Province of Ontario, some credits may be given towards the examinations required for membership of the Professional Engineers Association.

APPRENTICESHIP

Training for some technician occupations such as tool-and-die maker, instrument technician or radio technician, is obtained through formal apprenticeship schemes regulated by the Apprenticeship Branch of provincial Departments of Labour.

Apprenticeship consists of training while employed together with several weeks attendance, each year of apprenticeship, at municipal or provincial training institutes to acquire theoretical related subject knowledge.

TABLE 1—EDUCATIONAL ESTABLISHMENTS

NAME OF EDUCATIONAL ESTABLISHMENT	Duration of Course—Years	Electrical	Electronic	Mechanical	Instrumentation	Chemical	Architectural	Civil	Surveying	Agriculture	Fisheries	Food Processing	Forestry	Papermaking	Printing	Mining	Petroleum	Gas	Metallurgy	Atomic Energy	Textiles	Aeronautics	REMARKS
		TECHNOLOGIES																					
BRITISH COLUMBIA																							
Vancouver Vocational Institute—Vancouver	2																						Two-year Advanced Technical Course
**British Columbia Institute of Technology—Vancouver	2	x	x	x	x	x	x	x	x			x	x			x	x	x	x				Broadcasting; Business Administration. Scheduled to open, September, 1964
University of British Columbia	1									x													Diploma Course
ALBERTA																							
Southern Institute of Technology—Calgary	2/3	x	x	x			x	x	x								x					x	Industrial Laboratory (Chemical): Drafting: Construction: Surveying: Automotive: Power Plant Engineering: Refrigeration and Air-conditioning
**Northern Institute of Technology—Edmonton	2	x	x		x		x	x										x					
Schools of Agriculture—Olds, Vermilion and Fairview	2									x													Diploma Course
SASKATCHEWAN																							
**Central Saskatchewan Technical Institute—Saskatoon	2																						Scheduled to open, Fall, 1963
South Saskatchewan Technical Institute—Moose Jaw	2	x		x			x	x															Secretarial Science: Accounting
School of Agriculture—Saskatoon	2									x													Diploma Course

MANITOBA																							
**Institute of Technology—Winnipeg																							Scheduled to open, Spring, 1963
University of Manitoba—Winnipeg	2									x													Diploma Course
ONTARIO																							
Lakehead College of Arts, Science & Technology—Port Arthur	2/3						x						x										Engineering Technology (first year of 3 year course) Engineering Technology (both years of 2 year course)
**Northern Ontario Institute of Technology—Kirkland Lake																							Scheduled to open, September, 1962
Provincial Institute of Mining—Haileybury	2															x							
Ryerson Institute of Technology—Toronto	3	x	x	x	x	x	x	x							x			x	x			x	Sanitary Inspector's Course: Secretarial Science
The Eastern Institute of Technology—Ottawa	3	†	x	x	†	x		‡										‡	†			†	Industrial & Business Management Technology
Hamilton Institute of Technology—Hamilton	3	x	x	x	‡	‡		‡										‡	‡		x	†	Industrial & Business Management Technology
Western Institute of Technology—Windsor	3	†	x	x	‡	x		‡										‡	‡		x	‡	
Ontario Agricultural College—Guelph	2									x													Diploma Course
Western Ontario Agricultural School—Ridgetown	2									x													Diploma Course
Kemptville Agricultural School—Kemptville	2									x													Diploma Course

NOTE:
† 2 years of 3-year course
‡ 1 year of 3-year course

TABLE 1—EDUCATIONAL ESTABLISHMENTS—*Continued*

NAME OF EDUCATIONAL ESTABLISHMENT	Duration of Course—Years	Electrical	Electronic	Mechanical	Instrumentation	Chemical	Architectural	Civil	Surveying	Agriculture	Fisheries	Food Processing	Forestry	Papermaking	Printing	Mining	Petroleum	Gas	Metallurgy	Atomic Energy	Textiles	Aeronautics	REMARKS
QUEBEC																							
Institut des Arts Graphiques—Montréal	3														x								Bookbinding: Photography
Institut des Arts Appliqués—Montréal	3/4																						Furniture: Ceramics: Interior Decorating:
Institut de Papeterie—Trois-Rivières	3													x									
Institut des Textiles—St. Hyacinthe	3/4																				x		Chemistry: Dyeing
Institut de Marine—Rimouski																							Navigation (1 and 2 years): Marine Engineering (3 yrs): Wireless (2 yrs).
Instituts de Technologie: d'Arvida; de Chicoutimi; de Hull; de Lauzon; de Rimouski; de Sherbrooke; de Montréal; de Shawinigan; de Québec; de Trois-Rivières; Laval (Montréal)	3	x	x	x	x	x													x			x	Refrigeration
Macdonald College (McGill University)—Ste. Anne de Bellevue	2									x													Diploma of Technical Studies in Agriculture
Agricultural Technical Institute—Ste. Anne de la Pocatière	3									x													Diploma of Technical Studies in Agriculture
**Agricultural Technical Institute—St. Hyacinthe	3																						Scheduled to open, May, 1964
École de Laiterie de la Province de Quebec—St. Hyacinthe	3									x													Agricultural Technology

NOTE:
In addition, 29 Trade Schools across the Province offer the first or the first and second years of the technical courses.

NEW BRUNSWICK																							
New Brunswick Technical Institute—Moncton	2	x	x	x			x																Drafting: Secretarial Science: Accounting
NOVA SCOTIA																							
Nova Scotia Land Survey Institute—Lawrencetown	2								x														Leading to licence as Land Surveyor
Nova Scotia Agricultural College—Truro	2									x													Diploma Course
**Nova Scotia Trade & Technical Institute—Halifax																							Scheduled to open, Fall, 1963
NEWFOUNDLAND																							
**St. John's College of Trade & Technology—St. John's	2	x	x	x			x	x								x							Scheduled to open, September, 1963

NOTES:

(1) Establishments marked thus ** are at present under construction and complete details of curricula are not available.

(2) Not all establishments offer complete technical courses. The first or first and second years may be taken in schools serving young people near home. It is then necessary to take the final year in another centre.

(3) Many establishments are at present being extended and further courses will no doubt be added to the curricula. Reference should be made to the individual schools for more recent information.

NOVEMBER, 1962

TRAINING IN INDUSTRY

There is a wide variety of training methods in industry. Instruction may be given in formal, company-operated classrooms, supplemented by on-the-job-training. These methods are often directed towards training for a specific job or a cluster of related jobs. Workers with other companies may receive almost all of their training on the job and take their theoretical training on a part-time basis. Employers who do not provide training schemes may offer encouragement to their employees in the form of payment of fees and time off to take part-time and evening studies.

Those intent on becoming well qualified should make every effort, if they train in industry, to obtain employment with companies known to have good training programs. These firms are selective about their employees, preferring those with a good educational background and vocational or technical high school graduation.

PERSONAL QUALITIES NEEDED

What do technicians need to get ahead? In addition to the personal qualities already mentioned, technicians, no matter what their field or particular function, must possess the following "success factors" if they are to get ahead.

Ability to express themselves clearly and exactly—As in all fields of co-operative endeavour, communication between people is of the utmost importance. Technicians must take a real interest in the way in which their thoughts are expressed; they must constantly try to write correctly and clearly, and must have the habit of reading what they have written critically and analytically, to make sure that they cannot be misread or misunderstood.

A liking for and ability in the sciences and mathematics and the ability to learn complex techniques—Technical teams, in any enterprise, use sciences such as physics and chemistry; they use applied sciences such as mechanics; and they use tools of science such as trigonometry, geometry and calculus. For obvious reasons, a liking for these subjects is a prerequisite.

A genuine interest in study—There are two main reasons why this quality is important. The first is that after graduation, technicians are only part way to becoming specialists in their chosen field. Considerable work experience, involving more study, is necessary to become fully competent in a particular industry. The second reason is that technologies are changing rapidly. Further study, probably throughout the technician's lifetime is necessary to keep up with these changes.

Accurate and careful nature—The ability to take accurate readings and careful measurements is essential, as is the ability to make a sound assessment of those readings.

Persistence and patience—Often technicians are called on to prepare drawings, make calculations or set up complex equipment over and over again before the next stage of development can be carried out. The qualities of persistence and patience are therefore needed to see a problem through to its final conclusion.

Ability to get along with others—In all teamwork the ability to get along with others is a key factor to success. In addition, technicians are often in supervisory jobs and, at times, are called on for leadership.

Finally, technicians must be willing to get their hands dirty once in a while and be prepared to undertake some of the tasks of the bench hand.

TABLE 2—TYPICAL OCCUPATIONS

These occupations are well within the reach of good technicians after several years experience in industry	Electrical	Mechanical	Instrumentation	Chemical	Architectural	Civil	Forestry	Papermaking	Mining	Metallurgical	Aeronautical	Textiles	Others
Acid tester				x									
Aerodynamicist											x		
Air traffic controller											x		
Amalgamator										x			
Annealing foreman		x								x			
Boss miner									x				
Broadcasting technician	x												
Chemical tester				x									
Technical librarian	x	x	x	x			x	x	x	x	x	x	
Cloth tester												x	
Contractor—building	x					x							
Control supervisor	x		x							x			
Computer design technician													x
Clerk-of-works					x	x							
Camera technician													x
Dairy technologist													x
Draftsman	x	x	x	x	x	x	x	x	x		x		
Designers—													
machine tools		x									x		
fixtures		x											
jigs		x											
industrial machines		x											
Driller—seismograph									x				
Dyer—textiles												x	
Estimator	x	x	x		x	x	x				x		
Foreman	x	x	x	x	x	x	x	x	x	x	x	x	x
Geodetic computer									x				
Heat treatment technician		x								x			
Inspector	x	x	x	x	x	x				x	x	x	
Instrument technician	x	x	x	x				x	x	x	x	x	
Instructor—vocational													x
Illustrator—technical	x	x	x								x		
Illustrator—scientific				x			x						x
Job captain					x								
Model maker	x	x	x	x	x	x					x		
Maintenance engineer (licenced)											x		
Meteorological technician													x
Metallographer										x			
Mine captain									x				
Oils tester									x				
Pulp tester								x					
Power plant engineer	x	x											
Production manager	x	x	x	x				x	x	x	x	x	x
Production planner	x	x	x	x				x		x	x	x	x
Purchasing agent	x	x	x	x	x			x		x	x	x	x
Quality control manager	x	x	x	x				x		x	x	x	x
Radar technician	x												x
Recording engineer	x												
Surveyor					x	x	x		x				
Stationary engineer (certified)	x	x							x				
Sand technician										x			
Seismic computer									x				
Spectroscopist			x	x						x			
Soil technologist													x
Supervisor	x	x	x	x	x	x	x	x	x	x	x	x	x
Teacher—vocational	x	x	x	x	x	x	x	x	x	x	x	x	x
Teacher—technical	x	x	x	x		x	x	x	x	x	x	x	x
Technical writer	x	x	x	x		x				x	x		x
Television studio technician	x												x
Technical salesman	x	x	x	x				x		x		x	x
Time study analyst	x	x	x	x		x		x			x	x	x
X-ray technician (industrial)	x	x								x			x

ADVANCEMENT

Advancement for technicians can lead to three types of position: another technician job at a higher paying level; a supervisory post in the technician group; or, with further experience and training, a job in the managerial ranks.

For ease of understanding, here are a few examples:

Design and Development—detail draftsman—design draftsman—checker—to Chief Draftsman.

Aeronautical Technology—detail inspector—flight inspector—and, after obtaining Department of Transport Aircraft Maintenance Engineers Licences, to Chief Aircraft Maintenance Engineer.

Civil Technology—design draftsman—scheduler—Estimator/Superintendent.

Production Planning—scheduler—estimator—buyer—Chief Purchasing Agent.

As in most kinds of work, advancement depends on such factors as job performance, capacity for higher level work and seniority. However, probably the most important single factor is the level of educational attainment.

It should be noted that the role of technicians, because of their specialized education and training, is that of assisting in a team, each team usually being headed by a member of the professions such as an architect, a chemist, an engineer or a biologist. There is very little doubt that technicians in certain functions such as research, design and development, find their promotional opportunities limited unless they obtain the further education and training required to enter the professions.

TECHNICIAN OR "PROFESSIONAL"?

While it is not the intention of this booklet to consider at any length the complex problem of vocational choice, it is considered necessary to point out certain factors which must be examined *before* any course of training is selected. Proper selection at this stage will avoid possible future disappointments.

There are two personal factors to consider: the role for which you are best suited and, secondly, your ambitions for future advancement. Your future will depend, in some measure, on the training route you first select. Your talents may best lead to a position, possibly a supervisory one, in the technician group: alternatively, you may have the intellectual capacity to train, via the university curriculum, for a professional career. As a third alternate, you should examine whether a marked interest in practical work would not be better utilized as a craftsman or production worker.

Courses in institutes of technology are designed for young people who:

1. Have a vital interest in the practical as well as some interest in the theoretical.
2. Are not expected to have the intellectual capacity for a university course.
3. Cannot afford university training viz., one or two years longer than the institute of technology; fees ranging from $300 to $600 compared with the $250 of the more expensive institutes.
4. Are not acceptable in university because their mathematics and sciences do not meet entrance requirements.

This, it is hoped, points up the significant differences between the requirements of the university and the technician's course of study.

There are other booklets in this Series—CAREERS IN NATURAL SCIENCE and CAREERS IN ENGINEERING—which are recommended reading if you require further information on these professions.

EARNINGS

The earnings of technicians vary from region to region, from industry to industry and with the degree of responsibility. In addition, job titles have different meanings for different employers. For example, in one company, an engineering aide may essentially be a statistical clerk; in another firm he may undertake duties of a highly technical nature. For these several reasons, comprehensive data cannot be included. In general, pay scales range from a starting rate of $3,600 rising to $8,000 per year for those with several years of experience. A few cases have been reported of institute of technology graduates receiving salaries in excess of $10,000 per year.

ORGANIZATIONS

At the present time, there are many different organizations for technicians; some are well established, others in the formative stages while others represent technicians in a particular province, industry or function. For this reason, only typical organizations can be given.

In the province of Quebec, the CORPORATION OF PROFESSIONAL TECHNICIANS OF THE PROVINCE OF QUEBEC (*Corporation des Techniciens Professionnels de la Province de Québec*) has been established over the past thirty years. By provincial legislation, the exclusive right to the titles *Certified Technician* (*Technicien Diplômé*) and *Professional Technician* (*Technicien Professionnel*) with designatory letters *certified technician,* C.T. (*technicien diplômé,* T.D.) and *professional technician,* P.T. (*technicien professionel,* T.P.) is held by members of the Corporation.

In the province of Ontario, the Association of Professional Engineers of the Province of Ontario operates a certifying scheme for several grades of technicians and a senior grade of technologists; academic qualifications are required together with practical experience which must be under the direction of registered professional engineers. A direct outgrowth of this scheme is the ASSOCIATION OF CERTIFIED ENGINEERING TECHNOLOGISTS AND TECHNICIANS OF ONTARIO. Similar schemes are under consideration in other provinces.

On a national scale, The Chemical Institute of Canada has established a certification scheme for chemical technicians and technologists.

Technicians in the aeronautical and related fields (e.g., electronic, metallurgical and the like) may obtain membership, in grades appropriate to their qualifications and standing, in the CANADIAN AERONAUTICS AND SPACE INSTITUTE.

One bargaining union, of which a number of technicians such as draftsmen and tool designers are members, is the AMERICAN FEDERATION OF TECHNICAL ENGINEERS, AFL-CIO.

EMPLOYMENT OUTLOOK

There is, at the present time, an unsatisfied demand for technicians and the employment outlook is excellent. Technicians are utilized by the fastest growing industries and employment opportunities have been far in excess of the supply from Canada's 29 establishments for technical education. Significant of future employment trends is the provincial/federal building program to increase these establishments to forty in the near future; this indicates that federal and provincial authorities anticipate a doubling of employment opportunities within the next few years.

For the future, there is a lack of precedent upon which to base exact predictions since technicians are a relatively new and evolving group. Probably the most important factor governing employment opportunities will be the rate of introduction of new machines, processes and products and similar technological development.

There can be no doubt that, with a continuance of the present rate of technical changes, employment opportunities for technicians will accelerate over the next decade. In addition, technicians with sound education and well qualified in their particular field will be better able to adjust to changing conditions and thus maintain employment: workers with limited skills may not.

SEEKING EMPLOYMENT

Institutes of technology have placement officers who, in cooperation with the local offices of the National Employment Service, arrange interviews with prospective employers and bring vacancies to the attention of students and graduates. Assistance is also available to students seeking employment during vacations and those who require casual employment during the academic year. Many students make contacts while working in this summer and part-time employment which often lead to permanent employment on graduation.

Vacancies, both for new entrants and those seeking to change jobs, are listed by the National Employment Service; they can also supply much additional assistance such as details of the latest salary scales, working conditions and prospects in a particular locality.

Government at all levels—municipal, provincial and federal—and the three branches of the Armed Forces, employ many technicians. Canada-wide competitions for federal government positions are advertised in public buildings, such as post offices and local offices of the National Employment Service, and the daily newspapers.

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Graphic Arts Industries Association
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National Employment Service
National Research Council
Provincial Institute of Mining, Ontario
Royal Architectural Institute of Canada
Ryerson Institute of Technology
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The Canadian Manufacturers Association
The Chemical Institute of Canada
The Engineering Institute of Canada
The Southern Alberta Institute of Technology
The Textile Technical Federation of Canada

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Shell Oil of Canada Limited

The Foundation Company of Canada Limited

The National Film Board of Canada

Trans-Canada Airlines

Trans-Mountain Oil Pipe Line Company Limited

Ryerson Institute of Technology

PHOTOS

Les sociétés et organismes ci-après ont gracieusement fourni les photographies qui paraissent dans la présente brochure.

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Le ministère de l'Agriculture du Canada

Canadian Aeronautics and Space Institute

La Société Radio-Canada

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Pulp and Paper Research Institute of Canada

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L'Institut agricole du Canada
Atomic Energy of Canada Ltd.
British Columbia Institute of Technology
Canadian Aeronautics and Space Institute
L'Association des constructeurs canadiens
Canadian Electrical Association
Canadian Electrical Manufacturers Association
Canadian General Electric Co. Ltd.
L'Institut forestier canadien
L'Institut canadien des mines et de la métallurgie
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The Canadian Council of Professional Engineers
L'Association des manufacturiers canadiens
L'Institut chimique du Canada
The Engineering Institute of Canada
The Southern Alberta Institute of Technology
The Textile Technical Federation of Canada

LA RECHERCHE D'UN EMPLOI

Les instituts de technologie, en collaboration avec les fonctionnaires des bureaux locaux du Service national de placement, voient à ménager des entrevues avec des employeurs éventuels, signalent les postes vacants aux étudiants et aux diplômés et aident ceux qui se cherchent un emploi au cours des vacances ou qui désirent un emploi intermittent pendant l'année scolaire. Souvent, des étudiants venant d'obtenir leur diplôme se voient offrir un emploi permanent par des personnes qu'ils ont connues lorsqu'ils travaillaient à temps partiel ou au cours des vacances.

Les débutants et ceux qui désirent changer d'emploi peuvent s'adresser au Service national de placement qui les renseignera sur les offres d'emploi, les échelles de salaire les plus récentes, les conditions de travail et les perspectives d'emploi dans un endroit déterminé.

Les gouvernements fédéral, provinciaux et municipaux, ainsi que les services de l'armée, de la marine et de l'aviation emploient un grand nombre de techniciens. Le gouvernement fédéral fait aussi paraître, dans la presse et par voie d'affiches dans les services publics,—bureaux de poste et bureaux locaux du Service national de placement,—des avis de concours pour des emplois vacants de la fonction publique.

En aéronautique et dans les domaines connexes (électronique, métallurgie, etc.), les techniciens peuvent devenir membres du *Canadian Aeronautics and Space Institute,* à des degrés divers, selon leurs titres et leur expérience.

Un certain nombre de techniciens, comme les dessinateurs et les dessinateurs-projeteurs (outils), sont membres de l'*American Federation of Technical Engineers, AFL-CIO.*

PERSPECTIVES D'EMPLOI

Pour satisfaire à la demande, il faudrait beaucoup plus de techniciens qu'il n'en existe actuellement; les perspectives d'emploi sont donc excellentes. On emploie des techniciens dans des industries qui se développent rapidement et les occasions d'emploi dépassent de beaucoup le nombre des diplômés des vingt-neuf établissements de formation technique du Canada. En vertu du programme fédéral-provincial de construction, le nombre de ces institutions sera porté à quarante dans un avenir prochain, ce qui constitue un indice important de la tendance future de l'emploi. On peut en conclure que les gouvernements fédéral et provinciaux s'attendent à ce que les offres d'emploi doublent d'ici quelques années.

En ce qui concerne l'avenir, il est impossible de prédire avec certitude, par manque de données antérieures, puisque les techniciens forment un groupe relativement nouveau et en évolution constante. Le facteur le plus déterminant pour les disponibilités d'emploi sera probablement le rythme d'adoption des machines, des procédés et des produits nouveaux ainsi que d'autres innovations techniques.

Si les transformations techniques continuent à se produire au rythme actuel, les possibilités d'emploi pour les techniciens se multiplieront sans aucun doute au cours des dix prochaines années. De plus, les techniciens ayant reçu une solide formation et acquis la compétence voulue dans leur sphère particulière s'adapteront beaucoup mieux aux changements et auront plus de chance de garder leur emploi que les travailleurs moins bien préparés.

SALAIRE

Les salaires des techniciens varient d'une région à l'autre, selon l'industrie et en fonction des responsabilités. La signification des titres mêmes varie suivant l'employeur. L'aide-ingénieur, par exemple, ne sera qu'un simple commis à la statistique dans un établissement, alors qu'il assumera des travaux de caractère hautement technique dans un autre. Il est donc impossible de donner des précisions. En général, l'échelle des salaires annuels va de $3,600, au début, pour atteindre $8,000, compte tenu des années d'expérience. On nous a signalé le cas de quelques diplômés des instituts de technologie qui touchent plus de $10,000 par an.

ORGANISATIONS

A l'heure actuelle, les techniciens sont groupés en plusieurs organisations. Quelques-unes sont bien assises, certaines ne sont qu'en voie de formation et d'autres, enfin, représentent les techniciens sur le plan provincial, industriel ou professionnel. Nous ne pouvons donc que mentionner les organisations types.

La *Corporation des techniciens professionnels de la province de Québec* est établie depuis plus de trente ans. Une loi provinciale accorde à ses membres le droit exclusif aux titres de *technicien diplômé* (T. D.) et de *technicien professionnel* (T. P.).

En Ontario, l'*Association of Professional Engineers of the Province of Ontario* accorde des certificats à plusieurs classes de techniciens et un certificat supérieur de technologiste. Pour y avoir droit, il faut avoir reçu la formation théorique requise et, en outre, avoir acquis de l'expérience sous la direction d'ingénieurs professionnels inscrits. Ce régime a donné naissance à l'*Association of Certified Engineering Technologists and Technicians of Ontario*. Des régimes du même genre sont actuellement à l'étude dans d'autres provinces.

Sur le plan national, l'Institut canadien de chimie accorde des certificats aux techniciens et aux technologistes en chimie.

TECHNICIEN OU «PROFESSIONNEL»?

Bien qu'il ne soit pas ici question d'étudier à fond le problème complexe que pose le choix d'une carrière, il y a lieu néanmoins de signaler certains facteurs à considérer *avant* de procéder au choix d'un cours de formation. Un choix judicieux à ce moment permettra d'éviter les déceptions dans l'avenir.

Deux facteurs personnels entrent en jeu: d'abord le rôle qui conviendra le mieux à vos aptitudes, puis vos ambitions quant à l'avancement. Votre avenir dépendra, dans une certaine mesure, du genre de formation sur lequel votre premier choix se sera fixé. Selon vos talents, vous pourrez devenir surveillant d'un groupe de techniciens ou professionnel après avoir poursuivi des études à l'université; enfin, si vous vous intéressez particulièrement aux travaux pratiques, vous ne sauriez mieux faire qu'opter pour une carrière d'ouvrier spécialisé ou de travailleur de la production.

Les cours d'instituts de technologie sont conçus pour ceux qui:

1. Portent un intérêt particulier à la pratique tout en s'intéressant, néanmoins, à la théorie.
2. Manquent des aptitudes voulues pour fréquenter l'université.
3. Manquent des moyens de fréquenter l'université dont les cours durent une ou deux années de plus que ceux de l'institut de technologie où les frais sont de $250 au maximum, contre de $300 à $600 à l'université.
4. Manquent en mathématiques et en science du minimum de connaissances permettant l'admission à l'université.

Ces différents points montrent, croyons-nous, la différence marquée entre les conditions requises pour des études universitaires et des études techniques.

Pour ceux qui désireraient se renseigner davantage, nous recommandons la lecture des brochures de la même série: CARRIÈRES DANS LES SCIENCES NATURELLES et CARRIÈRES DANS LE GÉNIE.

AVANCEMENT

Trois voies s'ouvrent au technicien: accepter un autre emploi, mieux rémunéré, de technicien, devenir surveillant d'un groupe de techniciens ou, avec l'expérience et la formation voulues, accéder à un poste de direction.

Voici quelques exemples.

Conception et mise au point. Dessinateur de détail, dessinateur-projeteur, vérificateur et jusqu'à dessinateur en chef.

Technologie de l'aéronautique. Vérificateur de pièces, vérificateur d'épreuves de vol et, après obtention de la licence de mécanicien d'entretien d'avions accordée par le ministère des Transports, jusqu'à premier mécanicien d'entretien d'avions.

Technologie en travaux publics. Dessinateur-projeteur, organisateur, estimateur-surintendant.

Organisation de la production. Organisateur, estimateur, acheteur, acheteur en chef.

Comme dans la plupart des domaines, l'avancement dépendra beaucoup de l'exécution du travail, de la capacité d'accomplir un travail de niveau supérieur, de l'ancienneté, mais plus encore, probablement, du degré d'instruction et de formation.

Il y a lieu de remarquer que dans une équipe, ordinairement dirigée par un professionnel, un architecte, un chimiste, un ingénieur, un biologiste, etc., le technicien, en raison de sa formation spécialisée, joue un rôle d'assistant. Pour lui, les occasions d'avancement, notamment en recherche, en dessin de modèles et en perfectionnement, sont certes limitées, à moins qu'il ne pousse son instruction et sa formation afin de pouvoir devenir membre d'une des professions.

TABLEAU 2—OCCUPATIONS TYPES

Ces occupations sont à la portée des bons techniciens ayant acquis plusieurs années d'expérience pratique dans l'industrie	Électricité	Mécanique	Instruments	Chimie	Architecture	Technologie civile	Technologie forestière	Fabrication du papier	Mines	Métallurgie	Aéronautique	Textiles	Autres
Vérificateur d'acides			x										
Aérodynamicien											x		
Contrôleur de la circulation aérienne											x		
Amalgameur										x			
Contremaître de recuit		x								x			
Entrepreneur à l'extraction									x				
Technicien—radiodiffusion	x												
Vérificateur de produits chimiques				x									
Technicien de bibliothèque	x	x	x	x			x	x	x	x	x	x	
Vérificateur de tissus												x	
Entrepreneur en construction	x					x							
Agent de régie	x		x							x			
Technicien en dessin de calculatrice													x
Conducteur des travaux					x	x							
Technicien de caméra													x
Technologiste de produits laitiers													x
Dessinateur industriel	x	x	x	x	x	x	x	x	x		x		
Dessinateur modéliste—													
machines-outils		x									x		
accessoires		x											
gabarits		x											
machines (industrie)		x											
Sondeur—sismographe									x				
Teinturier—textiles												x	
Estimateur	x	x	x		x	x	x				x		
Contremaître	x	x	x	x	x	x	x	x	x	x	x	x	x
Calculateur—géodésie									x				
Technicien—traitement thermique		x								x			
Inspecteur	x	x	x	x	x	x				x	x	x	
Technicien d'instruments	x	x	x	x				x	x	x	x	x	
Instructeur—formation professionnelle													x
Dessinateur illustrateur—													
Ouvrages techniques	x	x	x								x		
Ouvrages scientifiques				x			x						x
Contremaître des travaux					x								
Modelliste	x	x	x	x	x	x					x		
Mécanicien d'entretien (breveté)											x		
Technicien météorologiste													x
Métallographe										x			
Maître-mineur									x				
Vérificateur des pétroles									x				
Vérificateur de pâte à papier								x					
Mécanicien de centrale d'énergie	x	x											
Directeur de la production	x	x	x	x				x	x	x	x	x	x
Organisateur de la production	x	x	x	x				x		x	x	x	x
Acheteur	x	x	x	x	x			x		x	x	x	x
Directeur du contrôle de la qualité	x	x	x	x				x		x	x	x	x
Technicien de radar	x												x
Technicien d'enregistrement	x												
Arpenteur					x	x	x		x				
Mécanicien de machines fixes (breveté)	x	x							x				
Technicien des sables										x			
Calculateur sismologique									x				
Spectroscopiste			x	x						x			
Technologiste des sols													x
Surveillant	x	x	x	x	x	x	x	x	x	x	x	x	x
Professeur—													
Formation professionnelle	x	x	x	x	x	x	x	x	x	x	x	x	x
Formation technique	x	x	x	x		x	x	x	x	x	x	x	x
Rédacteur—ouvrages techniques	x	x	x	x		x				x	x		x
Technicien de studio de télévision	x												x
Vendeur—service technique	x	x	x	x				x		x		x	x
Analyste du chronométrage	x	x	x	x		x		x			x	x	x
Technicien en radiographie industrielle	x	x								x			x

Goût pour l'étude—Deux raisons rendent cette qualité importante. D'abord, le technicien, quoique ayant obtenu son diplôme, n'est pas encore un spécialiste dans la technologie qu'il a choisie; il lui faut acquérir une vaste expérience et poursuivre ses études s'il veut devenir vraiment compétent dans une industrie déterminée. Ensuite, les technologies évoluent rapidement. Pour se tenir à la page, le technicien devra continuer à étudier, probablement pendant toute sa carrière.

Précision et minutie—La précision dans les lectures, les relevés et les cotes, la minutie dans les mesures et leur juste appréciation sont essentielles.

Patience et persévérance—La patience et la persévérance constituent des qualités indispensables, car souvent les techniciens sont appelés à recommencer maintes et maintes fois des dessins, des calculs et le montage d'outillage compliqué avant de passer à la phase suivante des travaux et de parvenir à résoudre définitivement un problème.

Sociabilité—En tant que membre d'une équipe, le technicien, pour réussir, doit être d'un commerce agréable. De plus, le technicien occupe souvent un poste de direction et est parfois appelé à prendre des décisions.

Enfin, le technicien ne doit pas craindre de se salir les mains de temps à autre et il doit être prêt à travailler à l'établi, à l'occasion.

FORMATION DANS L'INDUSTRIE

Les modes de formation dans l'industrie varient beaucoup. C'est ainsi que certaines sociétés possèdent leurs propres salles de classe pour l'enseignement théorique auquel vient s'ajouter la formation en cours d'emploi. Il arrive souvent que cette formation soit donnée en vue d'une tâche déterminée ou d'un groupe de tâches connexes. Dans d'autres établissements, les travailleurs peuvent recevoir presque toute leur formation sur place et ne suivre des cours théoriques qu'à temps partiel. Il arrive que les employeurs n'ayant aucun régime de formation encouragent leurs employés à suivre des cours du soir ou à temps partiel en leur accordant un supplément et des heures de congé pour leur permettre d'assister à ces cours.

S'ils optent pour une formation dans l'industrie, les travailleurs qui veulent devenir des ouvriers compétents chercheront à obtenir un emploi dans des sociétés connues pour leur bon régime de formation. Ces sociétés choisissent leurs travailleurs et donnent la préférence aux diplômés des écoles secondaires techniques ou de formation professionnelle.

QUALITÉS REQUISES

Que faut-il aux techniciens pour réussir? Outre les qualités personnelles déjà mentionnées, le technicien qui veut réussir doit, quelles que soient sa sphère d'activité et ses fonctions, satisfaire aux conditions de réussite ci-après.

Élocution claire et précise— Comme dans tous les domaines de travail en collaboration, la communication avec ses semblables revêt ici une très grande importance. Le technicien devra savoir exprimer correctement et clairement ses pensées et prendre l'habitude de relire d'un oeil critique et analytique ce qu'il écrit afin d'acquérir la certitude qu'il sera bien compris.

Don des sciences et des mathématiques et facilité d'apprendre des techniques compliquées—Dans toute entreprise, l'équipe des techniciens a recours aux sciences,—physique, chimie, mécanique,—à la trigonométrie, à la géométrie et au calcul infinitésimal. Il est donc évident qu'il faut avoir du goût pour ces matières.

NOTA: De plus, 29 écoles de métiers, par toute la province, offrent la première année seulement, ou la première et la deuxième années des cours techniques.																						
NOUVEAU-BRUNSWICK																						
New Brunswick Technical Institute, Moncton	2	x	x	x	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Dessin industriel; secrétariat; comptabilité
NOUVELLE-ÉCOSSE																						
Nova Scotia Land Survey Institute, Lawrencetown	2	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	Prépare à la licence d'arpenteur
Nova Scotia Agricultural College, Truro	2	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	Diplôme de technicien
**Nova Scotia Trade & Technical Institute, Halifax	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Inauguration prévue pour l'automne de 1963
TERRE-NEUVE																						
**St. John's College of Trade & Technology, Saint-Jean	2	x	x	x	...	...	x	x	...	...	...	...	...	...	...	x	...	...	...	...	...	Inauguration prévue pour septembre 1963

NOTA:

(1) **—Ces institutions sont en voie de construction; leur programme d'études n'est pas disponible.

(2) Les institutions n'offrent pas toutes un cours technique complet. Les écoles locales ou avoisinantes peuvent offrir la première ou les deux premières années du cours de trois ans, mais il faudra fréquenter une école d'un autre centre pour compléter le cours.

(3) Bon nombre d'institutions sont en voie d'agrandissement et ajouteront sans doute d'autres cours à leur programme d'études. Les écoles particulières fourniront des renseignements plus à jour à ceux qui en désirent.

TABLEAU 1—INSTITUTS DE TECHNOLOGIE (*suite*)

NOM DE L'INSTITUT	Durée du cours—années	Électricité	Électronique	Mécanique	Instruments	Chimie	Architecture	Technologie civile	Arpentage	Agriculture	Pêcheries	Conditionnement des aliments	Technologie forestière	Fabrication du papier	Imprimerie	Mines	Pétrole	Gaz	Métallurgie	Énergie atomique	Textiles	Aéronautique	REMARQUES
QUÉBEC																							
Institut des Arts graphiques, Montréal	3														x								Reliure; photographie
Institut des Arts appliqués, Montréal	3 ou 4																						Meuble; céramique; décoration d'intérieur
Institut de Papeterie, Trois-Rivières	3													x									
Institut des Textiles, St-Hyacinthe	3 ou 4																				x		Chimie; teinture
Institut de Marine, Rimouski																							Navigation (1 et 2 ans); mécanique de marine (3 ans); TSF (2 ans)
Instituts de Technologie: d'Arvida, de Chicoutimi, de Hull, de Lauzon, de Rimouski, de Sherbrooke, de Montréal, de Shawinigan de Québec, de Trois-Rivières, Laval (Montréal)	3	x	x	x	x	x													x			x	Réfrigération
Collège Macdonald (Université McGill), Ste-Anne-de-Bellevue	2									x													Diplôme de technicien agricole
Institut de technologie agricole, Ste-Anne-de-la-Pocatière	3									x													Diplôme de technicien agricole
**Institut de technologie agricole, St-Hyacinthe	3																						Inauguration prévue pour mai 1964
École de Laiterie de la province de Québec, St-Hyacinthe	3									x													Technologie agricole

MANITOBA																							
**Institute of Technology, Winnipeg	2	x	x	x	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Cours pour mécanicien en machinerie (1 an) Inauguration prévue pour le printemps de 1963
L'Université du Manitoba, Winnipeg	2	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	Diplôme de technicien
ONTARIO																							
Lakehead College of Arts, Science & Technology, Port Arthur	2 ou 3	...	...	...	...	...	x	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	Technologie du génie (1re année d'un cours de 3 ans) Technologie du génie (les deux années d'un cours de 2 ans)
**Northern Ontario Institute of Technology, Kirkland Lake	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Inauguration prévue pour septembre 1962
Provincial Institute of Mining, Haileybury	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	
Ryerson Institute of Technology, Toronto	3	x	x	x	x	x	x	x	...	...	...	...	...	...	x	...	...	x	x	...	...	x	Cours d'inspecteur sanitaire; secrétariat
The Eastern Institute of Technology, Ottawa	3	†	x	x	†	x	...	‡	...	...	...	...	...	...	...	...	...	‡	†	...	...	†	Gestion industrielle et d'affaires
Hamilton Institute of Technology, Hamilton	3	x	x	x	‡	‡	...	‡	...	...	...	...	...	...	...	...	...	‡	‡	...	x	†	Gestion industrielle et d'affaires
Western Institute of Technology, Windsor	3	†	x	x	‡	x	...	‡	...	...	...	...	...	...	...	...	...	‡	‡	...	x	‡	
Ontario Agricultural College, Guelph	2	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	Diplôme de technicien
Western Ontario Agricultural School, Ridgetown	2	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	Diplôme de technicien
Kemptville Agricultural School, Kemptville	2	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...	...	...	...	Diplôme de technicien

NOTA:
† 2 années d'un cours de trois ans
‡ 1 année d'un cours de 3 ans

TABLEAU 1—INSTITUTS DE TECHNOLOGIE

NOM DE L'INSTITUT	Durée du cours—années	TECHNOLOGIE																					REMARQUES
		Électricité	Électronique	Mécanique	Instruments	Chimie	Architecture	Technologie civile	Arpentage	Agriculture	Pêcheries	Conditionnement des aliments	Technologie forestière	Fabrication du papier	Imprimerie	Mines	Pétrole	Gaz	Métallurgie	Énergie atomique	Textiles	Aéronautique	
COLOMBIE-BRITANNIQUE																							
Vancouver Vocational Institute, Vancouver	2																						Cours technique avancé de deux ans
**British Columbia Institute of Technology, Vancouver	2	x	x	x	x	x	x	x	x			x	x			x	x	x	x				Radiodiffusion; gestion d'affaires. Inauguration prévue pour septembre 1964
L'Université de la Colombie-Britannique	1									x													Diplôme de technicien
ALBERTA																							
Southern Institute of Technology, Calgary	2 ou 3	x	x	x			x	x	x								x					x	Laboratoire industriel (chimie; dessin industriel; construction; arpentage; automobile; technique d'installation d'énergie; réfrigération et climatisation
**Northern Institute of Technology, Edmonton	2	x	x		x		x	x										x					Inauguration prévue pour mars 1963
Écoles d'agriculture, Olds, Vermilion et Fairview	2									x													Diplôme de technicien
SASKATCHEWAN																							
**Central Saskatchewan Technical Institute, Saskatoon	2																						Inauguration prévue pour l'automne de 1963
South Saskatchewan Technical Institute, Moose Jaw	2	x		x			x	x															Secrétariat; comptabilité
École d'agriculture, Saskatoon	2									x													Diplôme de technicien

Les communications (rédaction de compositions et de rapports)

L'économie politique et les études sociales (selon la technologie)

Les frais d'étude annuels varient, selon l'institut et la technologie, entre $60 et $250 auxquels s'ajoutent de $20 à $100 pour les manuels et les instruments, bien que la plupart des instituts tiennent un magasin d'articles d'occasion. Dans le Québec, où le gouvernement assume les frais d'étude et le coût des manuels, les étudiants résidant dans la province n'acquittent donc aucun droit. Il faut prévoir les frais de subsistance dans le cas des élèves se trouvant éloignés de leur domicile. La chambre et deux repas par jour, selon les chiffres fournis par un institut, peuvent coûter de $15 à $20 par semaine.

Il est bon de mentionner que la plupart des cours des instituts sont complets, c'est-à-dire que les étudiants ayant obtenu leur diplôme peuvent être dirigés immédiatement vers un emploi sans avoir à poursuivre d'études, bien que certains le préfèrent. A certaines conditions, les diplômés des instituts de technologie (province de Québec) sont admis dans les collèges. Pour les étudiants ayant terminé un cours d'architecture le stage de cinq ans peut être réduit de deux ans. Les diplômés en chimie peuvent devenir membres de l'Institut de chimie du Canada s'ils subissent avec succès les examens écrits qu'exige cet organisme. En Ontario, on accorde certains crédits dont il est tenu compte aux examens requis pour devenir membre de l'Association des ingénieurs professionnels.

APPRENTISSAGE

La formation de certains techniciens, par exemple les outilleurs, les matriceurs, les techniciens d'instruments et les techniciens de radio, s'acquiert par voie d'apprentissage réglementé par la Direction de l'apprentissage des ministères provinciaux du Travail.

L'apprentissage comprend la formation en cours de l'emploi, à laquelle s'ajoute, pour chacune des années d'apprentissage, un cours de plusieurs semaines des instituts provinciaux ou municipaux de formation en vue de l'acquisition des connaissances théoriques pertinentes.

suivies par la formation en cours d'emploi, les régimes d'apprentissage ou les cours de formation à l'usine assurés par les employeurs constituent d'autres moyens de formation auxquels viennent s'ajouter des cours à temps partiel, du soir ou par correspondance.

Les techniciens n'ont pas tous reçu une formation particulière. Certains travailleurs sont devenus techniciens après avoir fait des études personnelles et reçu leur formation sur place, tandis que d'autres ont fait des études universitaires.

INSTITUTS DE TECHNOLOGIE

Les instituts de technologie offrent des cours postsecondaires d'un, de deux et, le plus souvent, de trois ans. Certains instituts (notamment dans le Québec) offrent une quatrième année d'études avancées. Les conditions d'admission varient selon la province et la technologie, allant de la 10e année au diplôme d'école secondaire; cependant, la plupart de ces cours exigent le diplôme d'école secondaire. Les étudiants des écoles secondaires désireux de poursuivre leurs études dans un institut de technologie devront donc considérer le niveau d'instruction exigé pour l'admission à un institut déterminé.

La plupart des instituts donnent des cours du jour et du soir; quelques instituts offrent également des cours par correspondance. Les cours du soir et par correspondance rendent particulièrement service à ceux qui doivent travailler à plein temps et aux travailleurs désirant se perfectionner.

Étant donné que les techniciens s'occupent surtout de l'application de principes établis plutôt que de la découverte de principes, les programmes des instituts comprennent à la fois des études théoriques et une formation pratique. Les étudiants consacrent environ la moitié de leur temps au laboratoire et à l'atelier où ils éprouvent et appliquent les théories enseignées en classe.

Les études théoriques comprennent, entre autres:

Les mathématiques (algèbre et géométrie avancées, calcul infinitésimal, etc.)

La sphère de spécialisation (chimie, physique, electricité, sylviculture, mines, architecture, textiles, etc.)

Les matières techniques connexes

PRÉPARATION ET FORMATION

Quel est le degré d'instruction et de formation requis des techniciens? Les tâches des techniciens sont d'une telle diversité qu'il n'est pas étonnant que ces derniers puissent acquérir leur instruction et leur formation de différentes façons. Le minimum d'instruction requis varie selon la technologie, l'industrie et la tâche particulière qu'assumera le technicien. Il y a lieu également de faire remarquer que la formation réglementaire, celle que dispensent les instituts de technologie, par exemple, assure au technicien les connaissances théoriques et pratiques,—en laboratoire et en atelier,—adaptées à des techniques compliquées; mais, comme dans tout travail d'ordre scientifique ou technique, une vaste expérience reste indispensable pour devenir réellement compétent. Cette compétence ne s'acquiert que sur place, à l'œuvre, et exige parfois,—selon la complexité des fonctions à remplir,—plusieurs années.

De l'avis des éducateurs, des associations professionnelles et de nombreux employeurs, le *diplôme d'un institut de technologie* représente la meilleure garantie d'obtenir un emploi de technicien, notamment dans le cas de fonctions exigeant une vaste connaissance en mathématiques et en sciences, ce qui deviendra le cas de la plupart des travaux d'ordre technique. Voici quelques-unes des nombreuses raisons qui militent en faveur du diplôme.

Des changements nombreux surviennent dans l'industrie,—innovations, méthodes et produits nouveaux dont il a été précédemment question,—et l'on prévoit que ces changements deviendront encore plus rapides et plus radicaux au cours des années à venir.

Pour choisir un programme de formation, il importe de connaître les répercussions de ces changements sur une vie de travail. Dans un monde en évolution, les diplômés des instituts ont un avantage marqué sur les techniciens dont la formation se limite à un domaine particulier quelconque. En raison des connaissances théoriques acquises dans ces instituts, les diplômés seront plus en mesure de s'adapter aux changements et ont ainsi de meilleures chances d'avancement parce qu'ils sont mieux qualifiés. De plus, à mesure que les occupations de techniciens s'établissent et se précisent davantage, on relève le degré d'instruction requis et l'on exige une formation plus suivie.

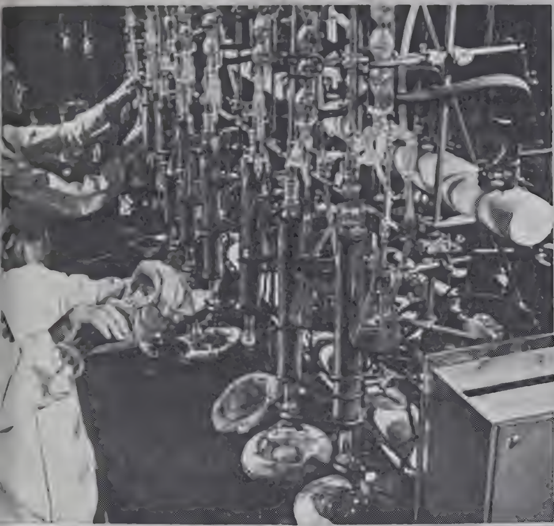
La formation préliminaire à l'emploi et la formation reçue dans des écoles secondaires techniques et de formation professionnelle,

dement mécanisée, exigent de solides connaissances en mathématiques et en fonctionnement des machines. Les techniciens ont à effectuer des calculs compliqués et à tenir à jour divers graphiques et registres afin d'obtenir l'utilisation la plus économique des machines et de la main-d'œuvre.

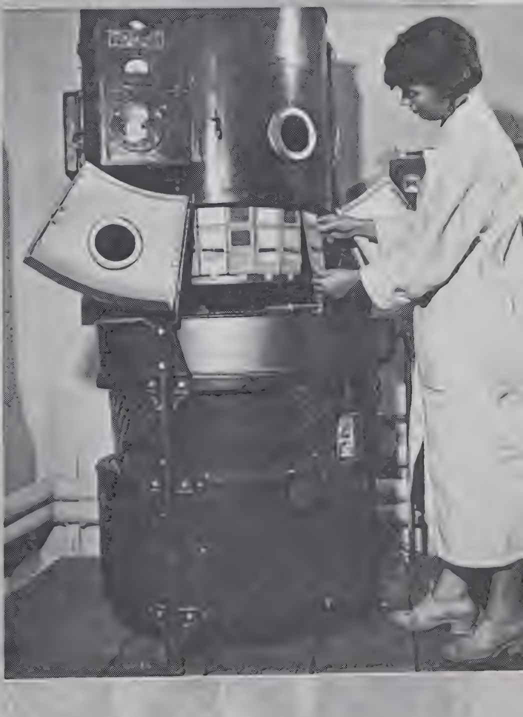
L'industrie porte une grande attention à la qualité; aussi emploie-t-elle de nombreux techniciens à la vérification, au contrôle de la qualité et aux épreuves. Les dessinateurs-projeteurs, les vendeurs, les acheteurs et les surveillants doivent également posséder une solide formation technique.

Les usines, presque toutes de construction récente, sont bien éclairées et climatisées. Elles se trouvent ordinairement dans de petits centres,—de fait, plus de la moitié d'entre elles se trouvent dans des localités d'une population inférieure à 25,000 habitants,—et sont souvent le centre de l'activité sociale et récréative.

Lorsqu'on examine les modes de formation qui mènent à une situation dans l'industrie textile, il importe de considérer que les diplômés d'instituts de technologie ont atteint le niveau d'instruction nécessaire à l'obtention de la licence de l'Institut du textile (Lic. I. T.). Le perfectionnement et l'expérience confèrent alors au licencié les qualités requises pour devenir membre associé de l'Institut, condition indispensable pour accéder aux postes de direction dans l'industrie.



a gamme des travaux que les techniciens ont appelés à exécuter dans l'industrie texle va de la recherche fondamentale à l'essi du produit fini, en passant par nombre e phases intermédiaires.



i-dessus: Recherches dans la chimie de fires nouvelles

i-contre: Le «Fade-orometer» permet de nesurer les effets de décoloration de la luière solaire sur les tissus teints.

TECHNOLOGIE DES TEXTILES

L'industrie textile, à l'origine de la révolution industrielle, il y a quelque 200 ans, n'a cessé d'évoluer. Elle est, de nos jours, devenue l'une des industries les plus complexes, par suite de l'introduction de fibres nouvelles dans la production et de la complication des machines et des procédés.

Bien que la plupart des filatures du Canada, avec leurs 80,000 travailleurs, soient surtout situées dans les centres industriels du Québec et de l'Ontario, l'industrie des textiles s'étend d'un océan à l'autre. Les fabriques de textiles primaires produisent des fibres et des filés et les transforment en tissus de toutes sortes destinés à la confection de vêtements, de tapis et de tricots, à l'ameublement et à des fins industrielles. D'autres entreprises teignent et apprêtent les filés et les tissus. Les compagnies varient quant à leur importance; certaines se spécialisent dans un secteur particulier, la filature, par exemple, tandis que d'autres font toutes les opérations.

Une industrie si complexe exige un personnel ayant reçu une formation en mathématiques, chimie et mécanique appliquées à la technologie des textiles.

Les positions offertes sont variées. Les fabricants de fibres synthétiques,—viscose, nylon, terylène, dynel, saran et orlon,—emploient dans leurs services de recherche et de perfectionnement des techniciens ayant reçu une formation en chimie; ces derniers s'occupent des problèmes que posent le traitement, le fini et le mélange des matières colorantes.

Les techniciens au service de fabriques de produits chimiques et de teintures s'occupent du perfectionnement, des épreuves et de la vente. En fabrication de machines pour l'industrie textile, des techniciens-mécaniciens se consacrent à la mise au point de techniques et d'outillage nouveaux et à leur application à des procédés tels que le filage, l'ourdissage, le bobinage, le moulinage, le tricotage et le tissage.

L'organisation et le contrôle de la production, l'étude des temps et des méthodes, l'estimation des prix, dans un industrie si gran-

*La manutention de tout alliage de plutonium dans le laboratoire de recherches de l'*Atomic Energy of Canada Limited *exige le port des vêtements de protection.*

Le fonctionnement du réacteur NRX à Chalk River (Ont.) est dirigé de ce tableau de commande.

Préparation de dessins détaillés d'après des devis descriptifs.

Montage, essayage, modification et fonctionnement de modèles de laboratoire et de matériel expérimental; façonnage d'éléments spéciaux destinés à des travaux d'expérimentation ou à des travaux témoins.

Fabrication et mise en place de systèmes électriques, électroniques, d'instruments et de leurs éléments.

A l'heure actuelle, l'*Atomic Energy of Canada Limited (AECL)* est le plus grand employeur de techniciens, mais l'activité dans l'industrie privée s'accentue dans de nombreuses branches du domaine nucléaire. La *Canadian General Electric Company Limited (CGE)* et l'*AMF Canada Limited* ont des contrats avec le gouvernement pour la fabrication d'éléments combustibles. La *CGE* est aussi le principal entrepreneur contractuel pour la construction d'une centrale de démonstration d'énergie nucléaire *(NDP)* à Rolphton (Ont.), projet auquel collaborent l'*AECL* et l'*Hydro-Electric Power Commission* d'Ontario.

L'*AECL,* de concert avec l'Hydro-Ontario, a établi les plans et commencé la construction de la première centrale nucléaire complète du Canada (*CANDU*—Canadian Deuterium-Uranium) à Douglas Point, sur la rive est du lac Huron. Dès son inauguration,—mise en service prévue en 1965,—cette centrale produira 200,000 kilowatts; son exploitation exigera donc un nombre croissant de techniciens.

Comme producteur d'énergie, le réacteur nucléaire remplace les chaudières chauffées au charbon ou au pétrole des centrales actuelles. La mise en service de stations nucléaires reste étroitement liée à la disponibilité et au coût des combustibles classiques et des ressources hydrauliques.

Il est peu probable que l'on construise dans un avenir rapproché des centrales d'énergie nucléaire dans les provinces de l'ouest, car le charbon et le pétrole y sont abondants et peu coûteux et l'on n'a pas encore exploité leurs ressources hydrauliques. On en prévoit, cependant, en Ontario où l'on a déjà capté la majeure partie des ressources hydrauliques.

L'exploitation et l'entretien des centrales d'énergie nucléaire seront probablement confiés aux commissions d'énergie et services similaires d'utilité publique. Les techniciens employés au fonctionnement de ces centrales seront vraisemblablement, du moins au début, plus nombreux que dans les centrales classiques, à cause du peu d'expérience acquise dans ce domaine, d'une part, et des mesures de sécurité à prévoir, d'autre part.

Les conditions de travail dépendent de l'industrie et, dans une certaine mesure, de l'âge de l'établissement. La chaleur et le bruit sont inhérents aux lamineries, comme la chaleur et la saleté le sont aux fonderies, et les techniciens occupés près des hauts fourneaux et des fours travaillent dans une chaleur intense. Les laboratoires, les salles de vérification, les bureaux de surveillance et les locaux de certains services tels que celui de l'entretien sont propres et climatisés.

ÉNERGIE ATOMIQUE

Le domaine de l'énergie atomique, relativement nouveau et en pleine expansion, offre aux techniciens un certain nombre de positions séduisantes, principalement en recherche pure et appliquée et en conception et perfectionnement de matériaux et d'outillage.

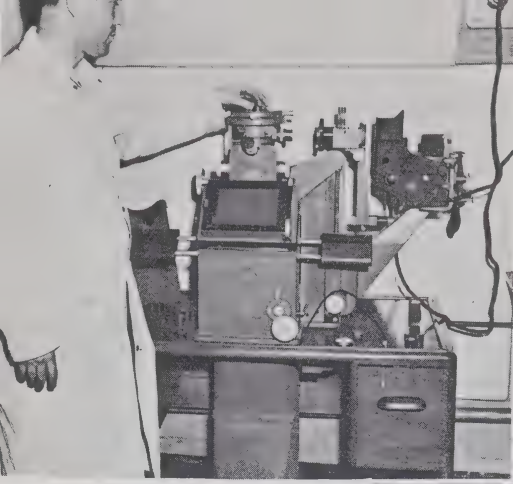
Malgré que le champ d'action soit vaste, on peut classer les nombreuses activités en trois branches principales: technologie minière; production de combustibles nucléaires et fabrication de réacteurs ainsi que de leurs parties constitutives (y compris le matériel de recherche); fonctionnement et entretien de réacteurs.

L'*Eldorado Mining and Refining Limited,* société de la Couronne, assume à la fois le rôle de producteur d'uranium et d'agent de l'État pour l'achat d'uranium d'entreprises minières privées; elle est chargée de l'extraction, du bocardage et du raffinage des minerais d'uranium. (Se reporter à la technologie minière, page 52).

L'*Atomic Energy of Canada Limited,* autre société de la Couronne, assume la tâche de concevoir et de mettre au point les réacteurs destinés à la production d'énergie et l'outillage connexe. Des services de la société s'occupent de l'amélioration des combustibles nucléaires, de la production d'appareils tels que la «Bombe» au cobalt 60 et autres appareils exigeant l'usage des isotopes radioactifs et le recours à la physique, à la radiochimie, à la physique des solides. Ces services effectuent également des recherches dans de nombreux secteurs impliquant les faisceaux de neutrons et la radiation.

La plupart de ces programmes sont confiés à des scientifiques et à des ingénieurs qui s'adjoignent des techniciens dont toutes les tâches, plus ou moins importantes, contribuent au succès des travaux de recherche. En voici quelques-unes.

Calculs relatifs à la vérification des plans.



Dans les laboratoires de recherche de la Dominion Engineering Limited, *l'étude de la structure des métaux se fait à l'aide d'un microscope pour l'examen des métaux.*

Essai d'un alliage pour en établir la teneur en phosphore

Échantillons de sable soumis à une épreuve de haute température dans un dilatomètre

TECHNOLOGIE DE LA MÉTALLURGIE

Depuis de nombreuses années, l'industrie de la métallurgie joue un rôle important dans l'économie canadienne. Actuellement, notre pays se place parmi les principaux producteurs au monde de nombreux métaux, y compris le nickel, l'or, le zinc, l'argent, le cuivre, le plomb, le fer et l'uranium.

La technologie de la métallurgie se divise en deux branches principales. La première concerne l'extraction des métaux de leurs minerais, le raffinage et les opérations qui s'y rapportent. La seconde traite des propriétés et de la structure des métaux et de leurs alliages, des méthodes appliquées pour les transformer en produits ouvrés et de l'utilisation appropriée de ces matières pour les constructions mécaniques.

L'importance que nous attachons à la transformation au Canada de nos minéraux et à leur conversion en produits ouvrés a multiplié, pour de nombreuses catégories de techniciens, les emplois dans les aciéries, les fonderies, les établissements d'usinage des métaux, les usines d'automobiles, les fabriques de pipe-lines et de moteurs.

Dans ces industries, les techniciens aident aux travaux ci-après.

Recherche. Examens et essais des métaux et de leurs minerais; préparation d'échantillons; amélioration des alliages; rassemblement et préparation de données statistiques.

Métallographie. Examens microscopiques des métaux et de leurs alliages.

Spectrographie. Analyse des métaux.

Traitements thermiques. Étude des procédés de durcissement, de trempe, de recuit et autres traitements thermiques.

Finissage. Étude des traitements et revêtements de protection.

Fabrication des métaux. Opérations de soudure, de moulage, de laminage, de façonnage et de forgeage.

Inspection. Décèlement des défauts internes au moyen des rayons X et méthodes similaires; épreuves de vérification de lots au cours du procédé de raffinage; examen des soudures; essais de vérification des propriétés physiques.

Exploitation d'établissement. Détermination des matières brutes nécessaires à l'alimentation des fours de fusion et des fonderies; surveillance des opérations.

La nouvelle et importante industrie de la pétrochimie offre aux techniciens formés dans les laboratoires industriels et aux diplômés en technologie de la chimie l'occasion de s'y tailler une carrière.

Le gaz naturel

Le progrès industriel d'un pays repose presque uniquement sur des sources d'énergie abondantes et sûres, à des prix raisonnables. Le Canada a la chance de posséder des gisements presque illimités de gaz naturel, dans les provinces de l'ouest. L'exploitation de ces gisements est en plein essor. En 1960, le gaz naturel fournissait 8 p. 100 de l'énergie totale au pays et l'on estime que vers 1980, la proportion atteindra 25 p. 100.

Les compagnies de service public engagent actuellement d'énormes capitaux dans l'aménagement de réseaux de transport et de distribution de gaz, et de stations de gazomètres; il en est de même pour les fabricants d'appareils industriels et domestiques fonctionnant au gaz. Il en résulte une multiplication d'emplois divers exigeant des connaissances en mathématiques, en sciences et en techniques compliquées. En voici quelques-uns.

Conception. Dessin de réseaux de pipe-lines et de distribution, de stations régulatrices et d'installations de gazomètres, d'appareils domestiques et industriels, travaux de recherche sur certains problèmes tels que celui de la corrosion.

Mise en valeur. Étude comparée des prix du combustible utilisé à des fins industrielles; estimations et propositions à l'intention des usagers dans l'industrie; choix d'équipement employé conjointement avec des fours, des fourneaux et des chaudières.

Construction. Estimation de prix; vérification; contrôle des contrats; études des emplacements.

Exploitation. Élaboration d'études des charges; répartition et contrôle des charges; surveillance et entretien des systèmes de contrôle; fonctionnement et surveillance d'installations industrielles et commerciales au gaz.

Le pétrole

La découverte et l'exploitation des gisements de pétrole dans l'ouest du Canada ont créé chez nous le besoin d'un personnel spécialisé en technologie pétrolière. Il existe dans ce domaine deux grandes catégories de techniciens: ceux qui aident les géologues et les géophysiciens dans les travaux de prospection et ceux qui travaillent effectivement à la production et au traitement du pétrole et du gaz en vue de la vente. Les instituts de technologie donnent des cours conçus pour permettre aux diplômés de se diriger vers l'une ou l'autre branche.

La prospection, le forage et la production constituent trois principales étapes de l'extraction du pétrole.

La prospection est entreprise par de petites équipes de travailleurs spécialisés, sous la direction de géologues ou de géophysiciens. Ils étudient la composition de la terre, les phénomènes sismiques et procèdent à des recherches gravimétriques. Les dessinateurs, les calculateurs, les préposés à la planchette, aux appareils électriques et autres instruments de mesure sont parmi les techniciens qui forment ces équipes.

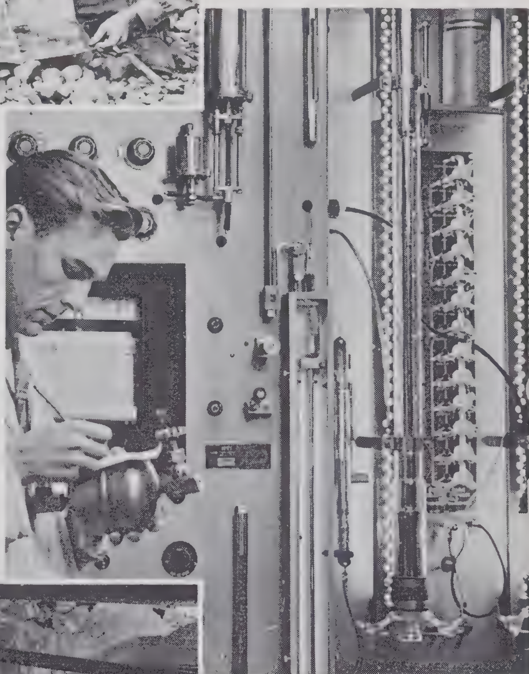
Viennent ensuite les travaux de forage des terrains prometteurs, afin de déceler la présence possible de pétrole. Des techniciens, dirigés par un ingénieur des pétroles, surveillent les travaux et y participent.

Certains techniciens, dans les bureaux régionaux de sociétés pétrolières et d'entreprises de prospection, interprètent les données que leur fournissent les équipes sur les lieux. Cependant, la plupart d'entre eux consacrent une grande partie de leur temps à des études topographiques dans des régions souvent accidentées et isolées.

Il faut être d'une constitution robuste pour travailler dans les champs pétrolifères, où la plupart des travaux se font en plein air et par des temps extrêmes. Les équipes de forage ne restent généralement pas plus d'un an dans une région; les déplacements du personnel de la prospection sont encore plus fréquents.

Les usages du pétrole brut sont très limités. On le transporte, habituellement par pipe-lines, vers des centres de raffinage. Le gaz naturel doit également être traité et est transporté aussi par pipelines. Il se présente donc des possibilités d'emploi pour les techniciens ayant reçu une formation appropriée dans la transformation et le transport du gaz.

Des groupes d'étude géologique sont organisés aux fins d'explorer le Grand Nord canadien.



Un technicien-chimiste essaie des échantillons reçus d'une installation de récupération de gaz d'une raffinerie.

Les instruments d'arpentage servent à établir les lignes pour les mineurs.

diamant, consignation au journal d'analyse des particularités et caractéristiques des carottes, échantillonnage et détermination de l'étendue du gisement.

Mine et bureau des levés. Un bon nombre de techniciens partagent leur temps entre la mine et le bureau d'études. Ils se servent d'instruments d'arpentage pour délimiter la progression de la mine; fournissent aux mineurs les lignes de pente et de direction; établissent des cartes de la marche des travaux dans la mine; calculent le tonnage de minerai concassé; déterminent les réserves de minerai; calculent les paiements forfaitaires à effectuer; étudient l'efficacité des méthodes et le rendement de l'outillage.

Laboratoire. Les techniciens titrent les échantillons fournis par la mine, l'usine ou les prospecteurs; ils procèdent aux analyses courantes de minerais naturels, de concentrés et d'échantillons de fonderie, se livrent à des essais permettant de contrôler et d'améliorer les méthodes en vue d'augmenter la récupération.

Surveillance. Quand ils ont acquis l'expérience suffisante, les techniciens peuvent devenir surveillants de la production et de groupes de mineurs, aider à la formation des nouveaux venus, enseigner les principes de sécurité et diriger des programmes de sécurité, ordonnancer les matériaux, les approvisionnements et la main-d'œuvre. Les postes de surveillant dans les mines peuvent préparer au travail de gestion.

Recherche. Depuis quelques années, on comprend mieux la nécessité de pousser davantage la recherche en ce qui concerne les techniques minières. Un certain nombre de grandes sociétés minières, le gouvernement fédéral et certains gouvernements provinciaux ont aménagé à cette fin de vastes laboratoires bien outillés. Les techniciens peuvent aider les scientifiques à effectuer des recherches sur la pression du sol, les méthodes de soutènement et les nouveaux moyens à employer pour l'exécution des travaux découlant de l'exploitation minière. Les recherches ne se poursuivent pas exclusivement dans les laboratoires. Les méthodes d'exploitation, par exemple, peuvent être étudiées dans les mines mêmes.

Pour obtenir de plus amples informations sur cette technologie, on peut se procurer la brochure de la même série: EMPLOIS MINIERS.

L'exercice de ces fonctions exige une connaissance approfondie des matériaux, de la terminologie appropriée, des sources d'approvisionnement, des techniques d'achat, des registres à tenir et autres connaissances similaires.

A la différence des ouvriers de métiers, ces techniciens ne sont pas tenus de faire fonctionner l'outillage d'imprimerie, mais ils doivent en connaître les principes, la capacité, la vitesse et le rendement qualitatif.

Pour évaluer, interpréter et effectuer des calculs précis, les techniciens recourent à des instruments, dont la règle à calcul est probablement le plus important, et à d'autres moyens tels que cartes, échelles, tables compliquées de calcul et de normes du genre de celles que publie la *Printing Industry of America—PAR Tables, Estimating and Printing Production Management.*

TECHNOLOGIE MINIÈRE

Les minéraux, une des principales richesses naturelles du Canada, ne sont dépassés en valeur que par les produits forestiers et agricoles. La technologie minière porte sur l'extraction de ces richesses, entre autres:

Les *minerais métalliques:* fer, zinc, plomb, argent, uranium, cuivre, nickel, or, cobalt.

Les *minerais non métalliques:* amiante, gypse, spath fluor, silicium.

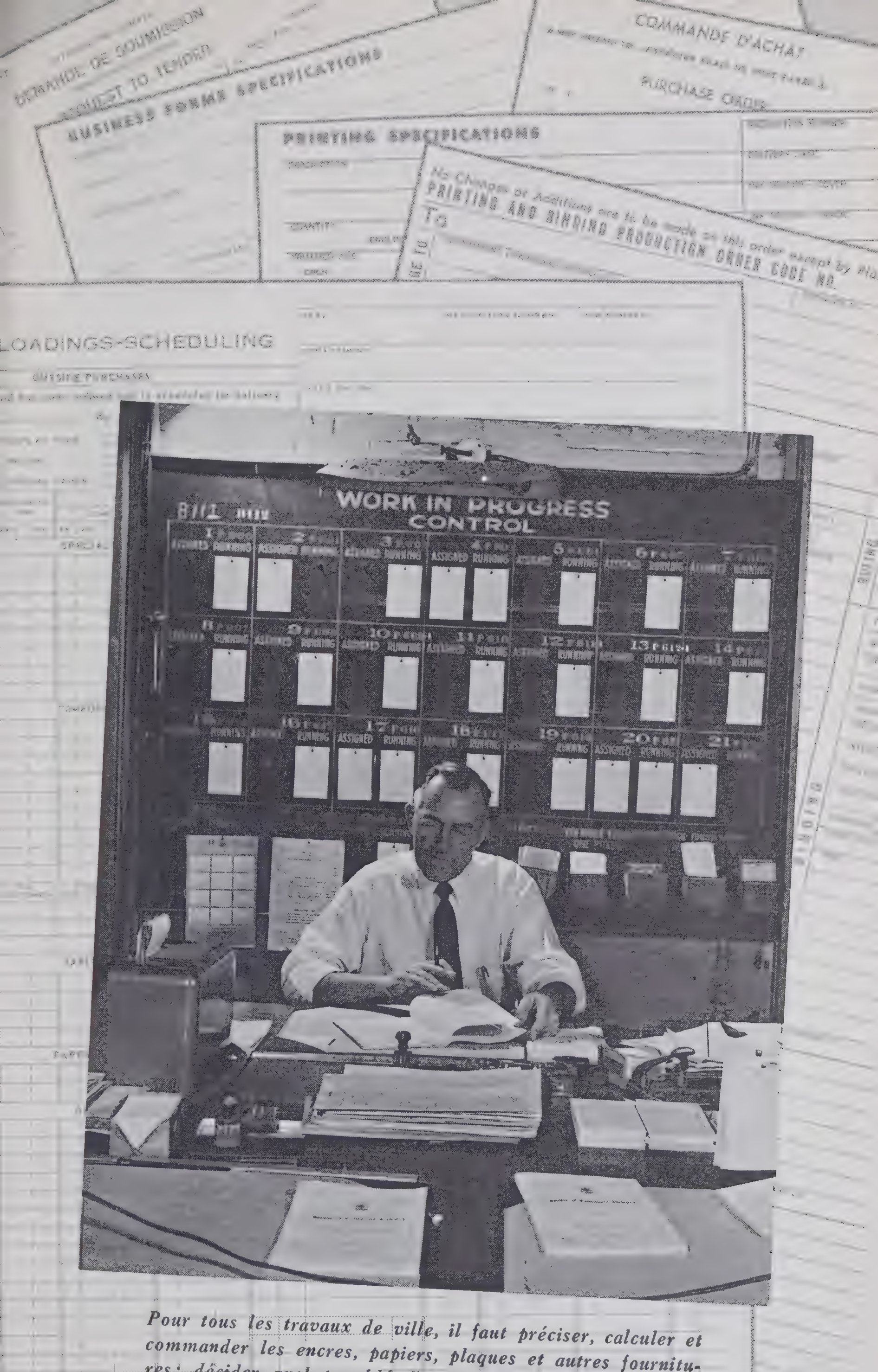
Les *matériaux de construction:* gravier, pierre, argile.

Les *combustibles:* charbon, pétrole, gaz naturel.

Le gaz naturel, le pétrole et ses dérivés ont depuis quelques années pris une telle ampleur que des instituts de technologie donnent des cours pour chacune de leurs technologies particulières.

Le vaste domaine de l'exploitation minière embrasse la prospection, la mise en valeur, les travaux à ciel ouvert et souterrains, le bocardage et autres traitements primaires, la mise sur le marché. Voici quelques-uns des principaux champs d'action.

Prospection. Les techniciens procèdent à des études géophysiques et géochimiques, établissent des cartes et des bornes de concessions. Ils s'occupent également à d'autres travaux: forage au



Pour tous les travaux de ville, il faut préciser, calculer et commander les encres, papiers, plaques et autres fournitures; décider quel procédé d'impression convient le mieux et établir le prix de revient des travaux.

TECHNOLOGIE DE L'IMPRIMERIE

L'imprimerie pourrait être considérée comme une technologie universelle, car il n'existe guère d'aspect de la vie quotidienne qui ne soit affecté par les imprimés.

Au Canada, les journaux tirent à quatre millions d'exemplaires par jour pour renseigner la nation. Chaque industrie, chaque bureau, chaque magasin utilise une variété infinie de formules, de graphiques et de papier à en-tête pour contrôler la marche des opérations et tenir des dossiers, tandis que pratiquement chaque entreprise recourt aux imprimés pour faire connaître ses produits ou les vendre. La valeur des livres, périodiques, revues et catalogues publiés annuellement pour instruire, renseigner ou divertir les lecteurs atteint quarante millions de dollars.

Pour répondre à cette demande, il existe au Canada plus de 2,800 imprimeries employant 31,000 personnes, depuis le petit atelier exploité par le propriétaire jusqu'à la grande entreprise dont les employés se comptent par centaines.

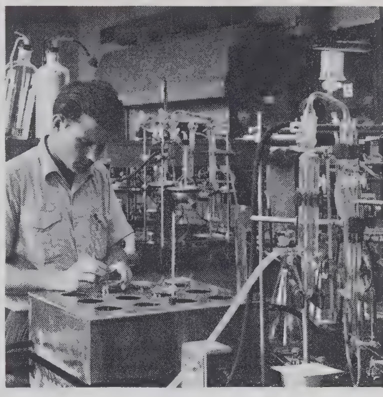
L'imprimerie exige des talents différents; des artistes pour concevoir et exécuter les illustrations, les couvertures et les maquettes, la photogravure et la reproduction de modèles photographiques; des conducteurs de presses et autres machines à imprimer versés dans la mécanique; des rédacteurs de nouvelles et des éditorialistes avec un certain don littéraire.

Il existe également un bon nombre d'autres tâches comme, par exemple, l'estimation du coût, l'organisation de la production et le contrôle des inventaires, qui exigent une certaine connaissance des mathématiques et des procédés d'impression. Ces fonctions sont confiées à des personnes qui, à toutes fins pratiques, peuvent être désignées sous le nom général de techniciens en administration d'imprimerie.

Selon l'importance de l'imprimerie, ces techniciens exercent une ou plusieurs des fonctions ci-après.

Pour tous les travaux de ville, ils spécifient, calculent et commandent encres, papiers, plaques et autres fournitures; choisissent le procédé d'impression à employer, établissent la justification et l'évaluation pour composition; estiment les délais et les frais de production; déterminent le prix des travaux.

Mesurage et pesage des arbres sur les lieux

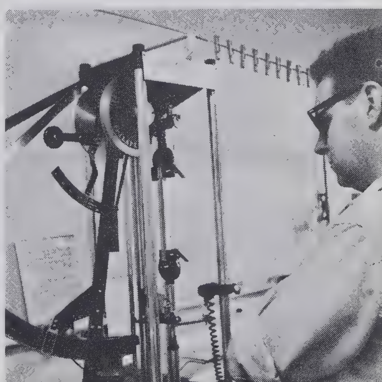


Les analyses chimiques se font en laboratoire.

Examen d'un nouveau procédé dans une installation d'essai

Épreuve des produits chimiques qui entrent dans la fabrication du papier

Essai de ténacité du papier à la forme



Essai du papier pour en déterminer la qualité, la ténacité, la résistance et la blancheur

TECHNOLOGIE DE LA FABRICATION DU PAPIER

La fabrication de la pâte et du papier est la principale industrie au Canada depuis un bon nombre d'années. Elle surpasse toutes les autres industries par la valeur de production, les exportations et les salaires payés.

La technologie de la fabrication du papier comprend trois sphères d'activité:

Transformation—du bois surtout, pour obtenir la pâte.

Traitement—de la pâte pour la convertir en papier et en carton.

Fabrication—avec le papier et le carton, de nombreux produits tels que les sacs, les boîtes en papier et le papier couché.

La fabrication de la pâte et du papier, y compris la production massive, devient de plus en plus complexe, si bien qu'elle exige les services de techniciens ayant reçu une formation en chimie, en électricité, en technique d'instruments et autres domaines scientifiques.

Les techniciens de laboratoire procèdent à des travaux de recherche fondamentale sur la chimie des bois, les procédés chimique et mécanique de fabrication de la pâte, le blanchiment et la pigmentation, l'essai des matières d'apport à la pâte, la modification des fibres, la pollution de l'air et des cours d'eau, et à des épreuves chimiques.

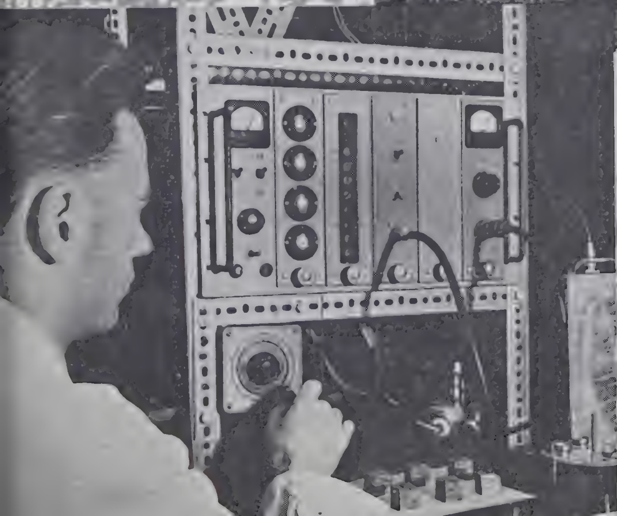
D'autres techniciens appliquent leurs connaissances en technologie mécanique à la solution des problèmes que posent la recherche et le dessin de modèles, la construction et le fonctionnement de machines, le perfectionnement d'appareils destinés à la fabrication de la pâte et du papier. D'autres encore surveillent les applications des procédés de laboratoire à la production massive.

Au cours de la fabrication, la pâte, le papier et les produits connexes sont soumis à des vérifications fréquentes afin d'en déterminer le poids, la résistance, la couleur, le fini et les dimensions. Une partie de ce travail est exécutée par des conducteurs de machines, mais un bon nombre de fabriques ont à leur service des techniciens de laboratoire, des vérificateurs de pâte et des vérificateurs de papier. Les vérifications vont des simples épreuves normales aux analyses les plus compliquées. Les fonctions d'autres techniciens de l'industrie du papier et des branches connexes, les techniciens-chimistes et les techniciens d'instruments par exemple, sont examinées ailleurs dans la présente brochure.

lessus: Une technicienne de labo-ire s'apprête à faire un examen roscopique de champignons nuisi- aux arbres.

ontre: Montage d'un appareil à urer la température du sol.

lessous: Ce technicien, à l'aide de pteurs radioactifs, examine un t de conservation du bois.



TECHNOLOGIE FORESTIÈRE

La technologie forestière se rapporte à la gestion et à la conservation rationnelles des régions boisées qui forment une grande partie de nos ressources naturelles.

Comment les arbres poussent, dans quelle région une espèce particulière poussera le mieux, comment assurer une récolte constante et comment dresser un inventaire précis du bois d'œuvre? Autant de questions et de problèmes qui se posent dans ce domaine. Il se produit un certain chevauchement de la technologie forestière et d'autres technologies. C'est ainsi que les techniciens forestiers sont amenés à s'intéresser aux problèmes du transport, —aménagement de routes dans les forêts, amélioration des cours d'eau; les mécaniciens-techniciens s'intéressent aux appareils de manutention mécaniques, tandis que d'autres sont occupés à la conservation de la faune et à la prévention des incendies.

Des techniciens forestiers entrent au service d'entreprises industrielles, entre autres les fabriques de pâte et de papier, notamment dans l'est du pays, et les entreprises de bois d'œuvre, dans l'ouest. La direction générale des travaux est confiée à des ingénieurs forestiers possédant un grade universitaire qui s'assurent les services de techniciens pour les aider dans un bon nombre de travaux. Les techniciens, agents de liaison entre les ingénieurs et les ouvriers forestiers, sont employés, entre autres, aux travaux ci-après:

Évaluation des coupes—inventaire des régions boisées.

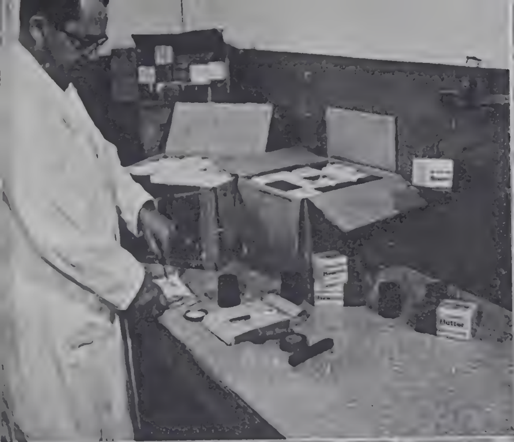
Photogrammétrie—détermination de données déduites de photos aériennes et qui serviront au traçage de levés, aux inventaires et à la construction de routes.

Travaux de compilation—examen des données recueillies lors de l'évaluation des coupes en vue d'établir des renseignements sur les forêts.

Surveillance des coupes—tracé des zones où doivent se pratiquer les coupes; délimitation des zones; marquage des arbres; surveillance de l'application des règlements de la compagnie et du gouvernement.

Travaux de recherche—l'aménagement de zones expérimentales nécessaires à l'observation du rythme de croissance, de la régénération, des dommages causés par les parasites et les maladies et des nombreux facteurs qui affectent une forêt.

Pour réussir en technologie forestière il faut une bonne formation et de l'entregent. Un bon nombre de tâches exigent des techniciens qu'ils soient robustes et consentants à travailler dans des régions isolées.



le conditionnement des produits alimen-
s, les épreuves et les examens sont im-
nts.

essus: Épreuves d'échantillons de beurre

ontre: Analyse du jus de betterave pour en
rminer la teneur en sucre

essous: La viande est classée.

Lorsque nos institutions seront en mesure d'assurer une formation plus spécialisée, on s'attend que les entreprises agricoles des secteurs public et privé emploieront un grand nombre de techniciens dont les services seront également requis dans les établissements commerciaux et industriels qui pourvoient aux besoins de l'agriculture. Leur connaissance des techniques de mécanique les plus efficaces leur permettra de faire connaître le meilleur parti à tirer des appareils mécaniques; leur connaissance de la chimie des sols, des engrais et des insecticides leur permettra de donner des conseils sur la meilleure façon d'utiliser ces produits; et ils pourront renseigner sur les plantes nouvelles et les animaux ou sur les plus récentes méthodes de classement et d'emballage.

CONDITIONNEMENT DES ALIMENTS

La technologie du conditionnement des aliments porte sur la préparation et la conservation industrielles des produits alimentaires.

Les différents procédés comprennent la dessiccation, la salaison, la réfrigération, le traitement thermique, la fermentation, la cuisson et l'emballage. On signale un bon nombre d'innovations dans l'industrie des produits alimentaires au cours des dernières années; la cryodessiccation, la déshydratation-congélation et le traitement par radiation ionisante deviendront peut-être bientôt choses courantes dans ce domaine.

La préparation du poisson, de la viande et des produits laitiers, le conditionnement et la mise en conserve des fruits et légumes, le conditionnement des céréales et provendes et la fabrication des boissons et de produits spéciaux sont autant de secteurs offrant des possibilités d'emploi.

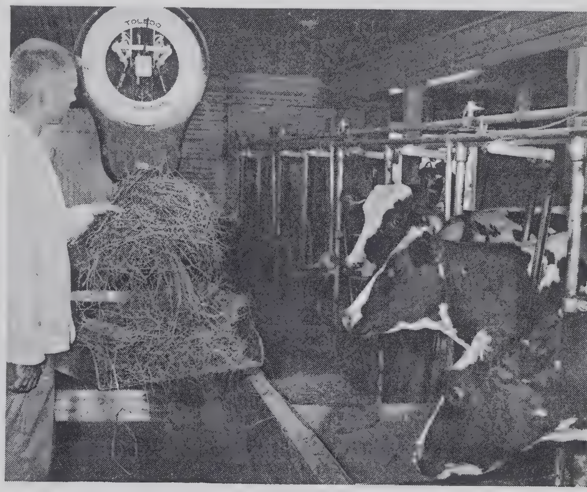
L'industrie des produits alimentaires utilise des procédés de fabrication, de machines et un outillage de plus en plus compliqués. En conséquence, un nombre de plus en plus grand d'emplois exigeront un personnel possédant une formation technique et de plus en plus spécialisée.

Les diverses tâches comprennent la surveillance et le fonctionnement d'outillage ou de procédés spécialisés dans l'établissement même; l'épreuve des matières premières, des matières en voie de traitement ou des produits finis, afin d'en déterminer l'uniformité, la pureté, l'acceptabilité et autres qualités.

Dans les laboratoires de recherche, des techniciens collaborent aux épreuves chimiques, physiques et bactériologiques ou aident à la mise au point de procédés nouveaux.

La production agricole a plus que doublé depuis vingt ans, grâce aux talents, aux connaissances et à l'ingéniosité d'un grand nombre de travailleurs, y compris des techniciens, dont l'apport a été précieux.

Les techniciens s'occupent de recherche fondamentale.



Ils font des essais en vue d'améliorer les méthodes d'alimentation et la qualité de la nourriture des animaux.

Ils appliquent leurs connaissances techniques et en mécanique au perfectionnement des machines.

AGRICULTURE

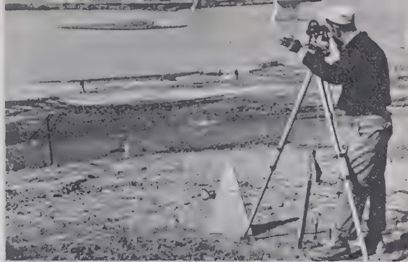
Il y a un siècle les fermes subvenaient amplement aux besoins des cultivateurs et composaient un groupe indépendant des autres groupes de la collectivité. De nos jours, la situation est bien différente. En général, les cultivateurs doivent compter sur d'autres technologies pour ce qui concerne les machines, les produits chimiques et les provendes, et sur les services d'utilité publique, par exemple l'électricité.

L'évolution va plus loin. Les fermes ont une plus grande superficie, où la culture y est plus intensive, plus spécialisée, leur exploitation exige plus de capitaux. Le Canada est un des plus grands pays exportateurs de denrées alimentaires au monde, mais la concurrence sur ce marché se fait de plus en plus vive. Afin de faire face à cette concurrence, tout en continuant à alimenter une population croissante, l'agriculture s'est transformée en une industrie complexe dont l'avenir n'est assuré que dans la mesure du succès que nous obtiendrons dans les applications à cette industrie des progrès réalisés en biologie, en chimie, en génie, en physique et en économique, en vue d'augmenter la production et, partant, de réduire les frais.

Ces changements donnent à l'agriculture un nouvel aspect. Les ouvriers agricoles deviennent moins nombreux, mais plus spécialisés. L'agriculture a également besoin de travailleurs spécialisés dans une ou plusieurs branches de la technologie agricole,—intermédiaires entre les agronomes spécialisés dans l'étude des sols et les ouvriers agricoles,—et qu'on peut appeler techniciens agricoles.

L'agronome spécialisé dans l'étude des sols assume encore la plupart des tâches qui entrent dans le cadre des attributions du technicien. Toutefois, on trouve des techniciens, principalement au service des gouvernements, à titre d'adjoints de recherches et aides de laboratoire. D'autres s'occupent d'épreuves, de classement et de vérification et agissent en qualité d'acheteurs de grains ou d'agents d'information.

Huit provinces donnent des cours d'agriculture, d'une durée habituelle de deux ans, préparant à un diplôme. Des mesures ont déjà été prises en vue de dispenser une formation plus spécialisée. A ce sujet, il importe de faire remarquer qu'on a institué depuis peu à Ste-Anne-de-la-Pocatière des cours postsecondaires qui préparent à un diplôme de technicien agricole. Ce diplôme sera peut-être reconnu pour l'admission dans la Corporation des techniciens professionnels de la province de Québec.



dessus:
ssin topographique

haut, à droite:
pentage

En technologie civile, toutes les fonctions, quelles qu'elles soient, sont importantes.

-dessus:
nducteur des travaux

-dessous: Surveillant
contremaître

tion, au zonage et aux études de la circulation indispensables à la bonne organisation d'une ville.

Tracer des dessins détaillés et des plans d'immeubles en acier profilé et en béton armé, de routes, ponts et autres voies de circulation.

Estimer la quantité et le coût des matériaux, fournitures et main-d'œuvre nécessaires aux entreprises de construction.

Surveiller les travaux de construction; examiner les pentes, coffrages, matériaux et méthodes de construction.

Déterminer les coordonnées de positions géographiques, délimiter les terrains, fixer des bornes (sous la direction d'un arpenteur-géomètre).

L'*arpentage* consistant à déterminer des positions et leur élévation avant les travaux de construction mécanique et de route est une branche distincte, bien qu'il constitue une partie importante de la technologie en travaux publics. Des instituts de technologie offrent des cours d'arpentage avec un double objectif: donner à ceux qui les suivent la compétence et les connaissances qui leur permettront de gagner leur vie dès leur entrée dans ce domaine, et préparer les étudiants en vue des examens des associations professionnelles,—nationales ou provinciales,—d'arpenteurs-géomètres.

Outre les possibilités d'emploi dans le domaine de l'arpentage, il existe également des occasions d'emploi auprès des compagnies de pétrole et de gaz, des sociétés d'ingénieurs-conseils, des services de levé de plans et de cartographie des gouvernements fédéral et provinciaux.

Beaucoup de techniciens en travaux publics travaillent à l'extérieur, par tous les temps, parfois dans des régions isolées et difficiles, aussi doivent-ils être robustes. Un esprit curieux et analytique et le souci du détail sont des qualités indispensables dans de nombreux emplois. Bien qu'on s'attende qu'ils suivent soigneusement les directives qui leur sont données, les techniciens en travaux publics doivent faire preuve d'initiative suffisante pour faire face aux situations difficiles et imprévues qui se présentent de temps à autre.

tecte dépend non seulement de sa compétence mais également du service personnel qu'il assure, des techniciens aimables, délicats et énergiques peuvent contribuer dans une large mesure à cette réussite.

Les bureaux d'architectes, qui comprennent des salles de travail et une salle de réception des clients, sont propres, bien éclairés et habituellement climatisés. Les techniciens occupés sur les chantiers de construction travaillent par beau temps comme par mauvais temps et doivent donc jouir d'une assez bonne santé.

TECHNOLOGIE EN TRAVAUX PUBLICS

La technologie en travaux publics consiste, en somme, dans le dessin et la construction d'ouvrages fixes, la planification et le zonage, les travaux d'arpentage, les levés de plans, et d'autres ouvrages de réfection ou de modification des terrains. Pour les techniciens, elle ouvre un champ d'activité très vaste chevauchant celui d'un grand nombre d'autres technologies. Par exemple, les techniciens en travaux publics travaillent en collaboration avec les électrotechniciens à la construction de centrales d'énergie électrique ou avec les techniciens-chimistes à l'aménagement de réseaux de pipe-lines de gaz et de pétrole.

La technologie en travaux publics comprend quatre grandes divisions comptant chacune un certain nombre de subdivisions:

Le *transport:* routes, rues, chemins de fer, viaducs, aéroports, ponts, tunnels et métros.

La *construction:* ponts, tunnels, métros, grands édifices et pylônes de lignes de transmission d'électricité.

L'*hydraulique:* barrages, installations de retenues des crues ou d'irrigation, ports, canaux et tunnels.

L'*hygiène publique:* réservoirs, systèmes de drainage et d'égouts, systèmes d'épuration.

Les techniciens en travaux publics exercent un grand nombre de fonctions, entre autres:

Aider les ingénieurs municipaux à établir le tracé des rues, systèmes d'aqueduc et d'égout et autres services ou à la planifica-

TECHNOLOGIE DE L'ARCHITECTURE

L'essor de l'industrie de la construction depuis la deuxième guerre mondiale a contribué à la création de nombreux emplois nouveaux pour les techniciens. Les architectes dressent les plans de grands bâtiments, mais confient aux techniciens à leur service un bon nombre de tâches qui leur incomberaient autrement.

Le travail des techniciens de ce groupe dépend de l'activité de l'employeur. Nous mentionnerons les principales fonctions, mais il arrive souvent que, suivant l'importance de l'entreprise, quelques-unes de ces fonctions soient combinées.

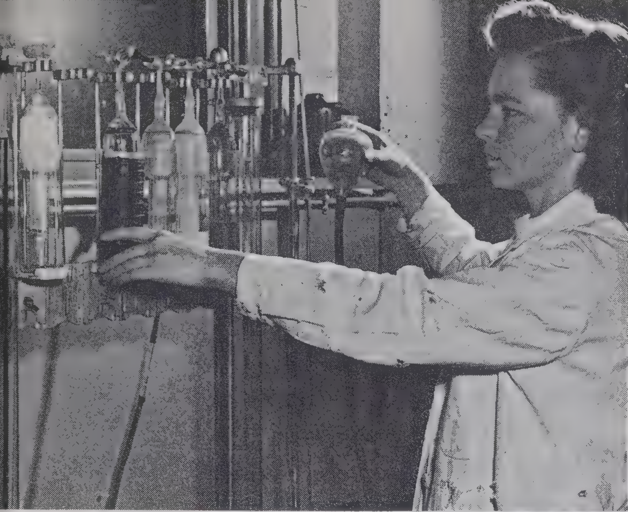
Les dessinateurs d'architecture établissent des dessins et exécutent des maquettes sous la direction d'un architecte. Les plans préliminaires étant approuvés par le client, les techniciens apportent les modifications désirées et exécutent les épures et les devis descriptifs destinés à servir sur le chantier de construction.

L'architecte adresse alors les plans et les devis aux entrepreneurs et les invite à soumettre des offres pour l'exécution des travaux. Dans les bureaux des entrepreneurs, les estimateurs analysent les prix et préparent des soumissions à l'intention des clients.

Au chantier, les techniciens agissent en qualité de conducteurs des travaux, de contremaîtres, d'inspecteurs, de surveillants ou de préposés au choix des matériaux.

Les demandes de techniciens viennent de bureaux d'architectes et d'ingénieurs-conseils, de services d'architecture des gouvernements fédéral, provinciaux et municipaux, d'agents d'immeubles, d'entrepreneurs en bâtiment, de maisons de commerce et d'entreprises industrielles, d'urbanistes, d'architectes-paysagistes et d'autres experts.

L'architecture étant l'art de concevoir de belles constructions, il importe que les architectes et leurs adjoints s'intéressent aux arts et soient doués pour le dessin. Il faut un esprit inventif, de la personnalité, de l'imagination et la faculté de se représenter les choses par l'esprit. De plus, il faut être pratique, afin de décider des méthodes et des matériaux à employer tout en tenant compte des limitations en matière de prix. Comme la réussite de l'archi-

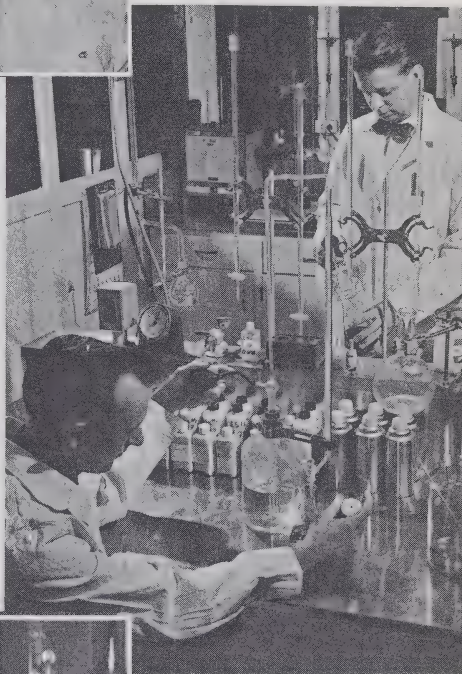


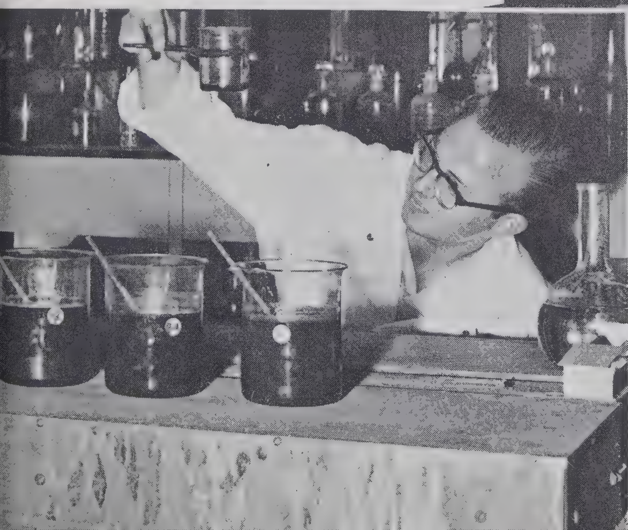
La chimie est à la base d'un grand nombre de procédés industriels. A peu près toutes les industries emploient des techniciens-chimistes.

Ci-dessus:
Un appareil Orsat employé dans l'industrie du caoutchouc synthétique pour l'analyse des gaz

Ci-contre:
Des techniciens en cosmétiques font des expériences avec des crèmes à main.

Ci-dessous:
Travaux de recherche dans un laboratoire de métallurgie





TECHNOLOGIE DE LA CHIMIE

La technologie de la chimie consiste dans l'application du travail de laboratoire à une production commerciale massive. Elle s'étend à la conception, à la construction et au fonctionnement d'installations et d'appareils. Ce vaste domaine est en plein essor. De 1958 à 1960, par exemple, les mises de fonds dans l'industrie chimique au Canada ont augmenté à un rythme trois fois plus grand que celui des autres secteurs de la fabrication.

Les techniciens sont appelés à travailler dans les industries du pétrole et de ses sous-produits, des textiles synthétiques, des peintures, des matières plastiques, des produits pharmaceutiques, des insecticides; du conditionnement des aliments; des métaux et des minéraux, etc.

L'activité des techniciens s'échelonne de la recherche, du perfectionnement, du fonctionnement d'une usine, du contrôle de la qualité, à la vente et au service. Plus particulièrement, les techniciens sont chargés des travaux ci-après:

Laboratoires industriels et de recherches: montent le matériel d'essai et le font fonctionner; utilisent des données mathématiques et chimiques aux fins de calculs et de mesures; procèdent à des analyses qualitatives et quantitatives.

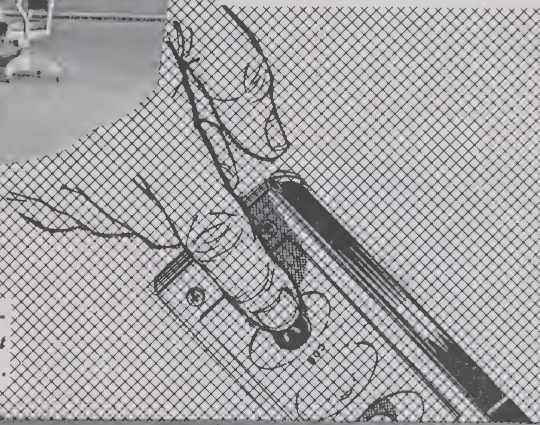
Mise au point et perfectionnement de procédés: les techniciens peuvent être appelés à construire des installations à échelle réduite et à en faire l'essai avant que la production massive ne soit autorisée. Lorsqu'il s'agit de préparer des mélanges de différents produits chimiques, ils travaillent sur des formules et procédés nouveaux avant que la production de ces mélanges ne soit autorisée. D'autres s'occupent d'épreuves de contrôle de la qualité qui vont de l'échantillonnage ordinaire aux analyses compliquées.

Surveillance d'installations: la demande de techniciens augmente partout où l'automatisation est adoptée.

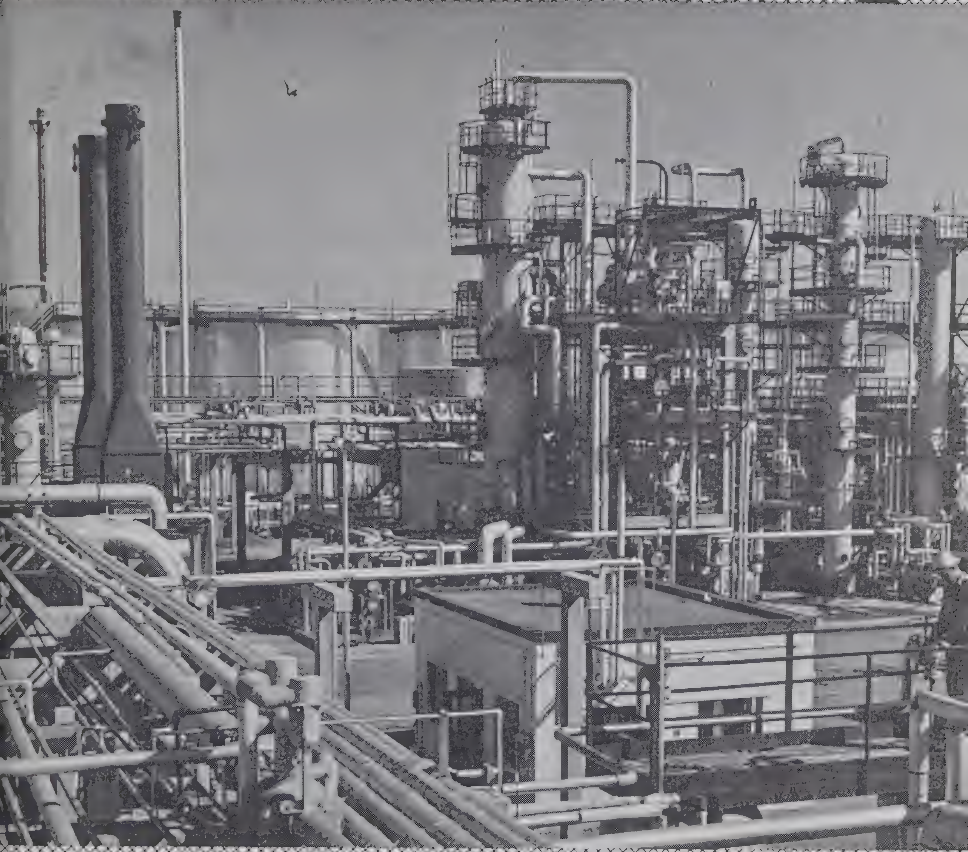
Le désir de connaître et la persévérance constituent les plus importantes qualités du technicien. En laboratoire, le souci du détail et l'acuité visuelle deviennent essentiels.

Les vapeurs et les odeurs, entre autres, sont des inconvénients que présentent les laboratoires, mais tout danger est écarté par une bonne ventilation. Les surveillants d'installations sont donc parfois astreints à supporter la chaleur, les vapeurs et la poussière.

*La salle de commande de la raffinerie de l'*Imperial Oil, *à Edmonton, où le technicien, au moyen de dispositifs, contrôle les groupes de raffinage, les enregisteurs de débit, les jauges de température et les indicateurs de pression*



Des tableaux panoramiques munis de diagrammes fournissent tous les renseignements voulus.



ciens ou mécaniciens formés par voie d'apprentissage. Les diplômés des instituts de technologie seront vraisemblablement employés à des tâches exigeant des connaissances théoriques; par exemple, dans une fabrique d'instruments: construction de maquettes et essai de nouveaux systèmes, préparation de plans de câblage et choix d'organes, disposition de systèmes en vue de nouveaux procédés industriels, recherche et interprétation de données techniques et scientifiques.

Dans l'industrie, également, les techniciens peuvent se voir confier le montage et la mise au point d'instruments de contrôle d'un procédé industriel particulier. La mise au point d'un procédé comporte la mesure d'éléments variables tels que les températures, les densités, l'écoulement et les niveaux de liquides, les pressions et l'humidité relative. De concert avec les ingénieurs, les techniciens établissent des dessins de projets indiquant les organes et les dispositifs les plus appropriés. Des ouvriers qualifiés procèdent alors à la mise en place des premiers éléments. Les lignes de transmissions électriques, les canalisations d'air, de liquide et à vide sont montées par des techniciens et reliées à des instruments de contrôle permettant d'en déceler les fuites et les défectuosités. Les graduations et les diagrammes des appareils de contrôle sont étalonnés et, finalement, on procède à la vérification de toute l'installation afin de s'assurer qu'elle fonctionne bien.

Ce ne sont là que quelques-unes des nombreuses tâches qui attendent les techniciens d'instruments. Leurs fonctions se transforment rapidement, de nouveaux problèmes surgissent constamment et la technique d'instruments s'applique à un grand nombre de nouveaux procédés industriels. Les techniciens doivent être prompts à remarquer les petits détails et aptes à saisir rapidement les instructions orales qu'ils reçoivent.

Les conditions de travail varient. Dans les fabriques d'instruments, les techniciens travaillent dans des bureaux d'études propres et bien agencés. Certains techniciens d'instruments sont amenés à travailler dans des lieux isolés, par exemple, lorsqu'il s'agit de la construction d'un pipe-line. Ceux qui s'occupent de mise au point, de réglage de procédés travaillent dans des installations, souvent à la chaleur, dans la saleté, la poussière et le bruit.

TECHNOLOGIE DES INSTRUMENTS

Les transformations technologiques apportées dans l'industrie et le commerce ont amené le remplacement du jugement humain par des commandes automatiques. Procédés de production ininterrompue, plus grande précision et réduction de possibilités d'erreurs sont devenus possibles grâce à la mise au point et au perfectionnement d'instruments de mesure et d'appareils indicateurs et de commande.

Les instruments employés de nos jours sont de types nombreux et variés, fondés sur les principes de l'électricité, de la mécanique, de l'hydraulique, de la pneumatique et peut-être de l'optique. En raison de ces nombreux principes et de la complexité croissante des procédés industriels, les techniciens d'instruments doivent posséder une connaissance profonde des mathématiques, de la physique et des sciences appliquées aux nombreuses utilisations des instruments et, de plus, connaître les techniques de la réparation de ces instruments.

Les deux principales sphères d'emploi sont celle des établissements qui conçoivent, fabriquent et vendent des instruments techniques, scientifiques, de laboratoire et d'optique, et celle des industries des produits chimiques, des raffineries de pétrole, de la papeterie, des services d'utilité publique (électricité) et du transport aérien. Un petit nombre de techniciens se trouvent également en météorologie, en géophysique et dans d'autres domaines scientifiques similaires.

Des emplois en technique des instruments continuent à être créés, aussi se produit-il un chevauchement considérable des fonctions de technicien en instruments, en mécanique, en chimie et en électricité. Il s'ensuit que ces fonctions varient d'une industrie à l'autre et, au sein d'une même industrie, d'une compagnie à l'autre. D'une manière générale, les techniciens mettent au point, montent, étalonnent, dépannent et réparent des instruments et des systèmes de commande.

Les travaux courants, par exemple, la réparation à l'établi et l'entretien, qui peuvent se faire sans procéder à une analyse théorique de chaque cas particulier, sont exécutés par des techni-

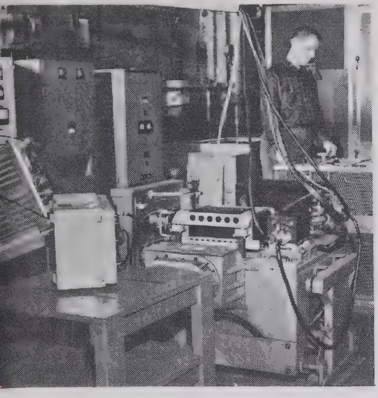
Les techniciens des transports aériens s'intéressent davantage au côté pratique de l'entretien des avions et au fonctionnement des installations d'un aéroport tels que les systèmes de radiogoniométrie, d'atterrissage et de communications.

Les techniciens de l'entretien sont parfois exposés au mauvais temps et, comme les services aériens fonctionnent vingt-quatre heures par jour, ils peuvent être appelés à travailler par postes et en fin de semaine.

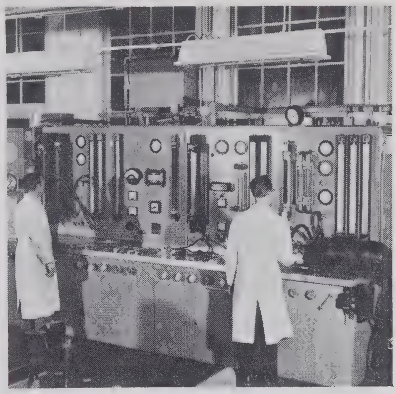
Les entreprises de transport aérien sont exploitées en vertu de règlements fédéraux stipulant que les préposés à l'entretien des avions doivent avoir la compétence voulue en la matière. Cette compétence s'acquiert dans des instituts de technologie. Par exemple, un diplôme décerné par la Section de technologie de l'aéronautique du *Southern Alberta Institute of Technology* dispense le détenteur de se présenter à la plupart des examens du ministère des Transports en vue de l'obtention des brevets de mécanicien d'entretien d'avions.

La gamme des occupations du mécanicien d'entretien d'avions va de celle de chef de service à celle de mécanicien dans les divisions de la remise à neuf, de la réparation, de la revision et du contrôle de la qualité dans des fabriques d'avions.

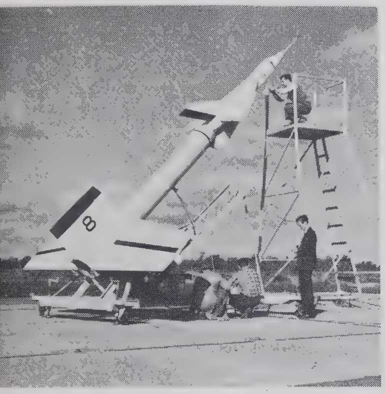
En aéronautique, la plupart des usines, hangars et laboratoires sont modernes, propres et bien éclairés. Comme on peut s'y attendre dans le cas d'une industrie relativement récente, les installations, l'outillage et le matériel sont des plus modernes.



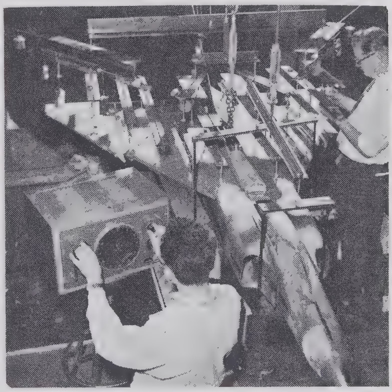
Les techniciens font des essais sur les facteurs ambiants: le froid, la chaleur, l'altitude, la vibration, etc.



Quelques-uns des appareils employés pour ces essais

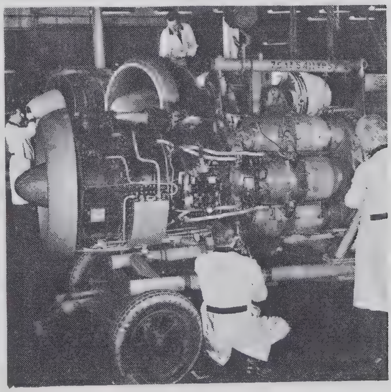


Les engins spatiaux sont montés et vérifiés par des techniciens.



Les prototypes sont soumis à des essais de résistance.

Examen de pièces comme ce dispositif de commande de soupape, de chaufferette



Vérification périodique des moteurs à réaction

TECHNOLOGIE DE L'AÉRONAUTIQUE

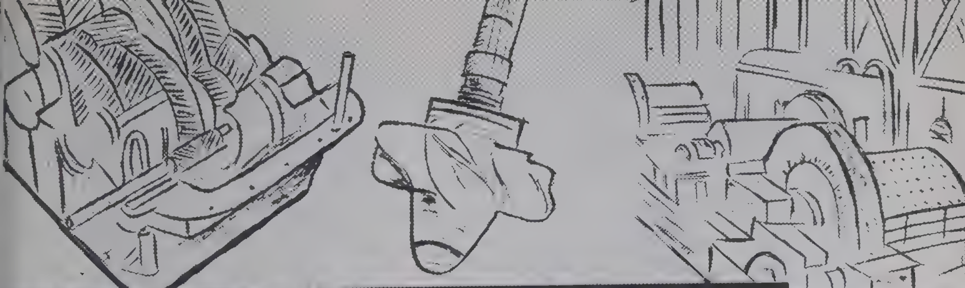
L'industrie aéronautique emploie plus de deux cents catégories de techniciens. Il n'est donc possible de ne donner qu'un aperçu général des diverses tâches. La monographie EMPLOIS DANS L'INDUSTRIE AÉRONAUTIQUE, de la même série, traite plus à fond du sujet.

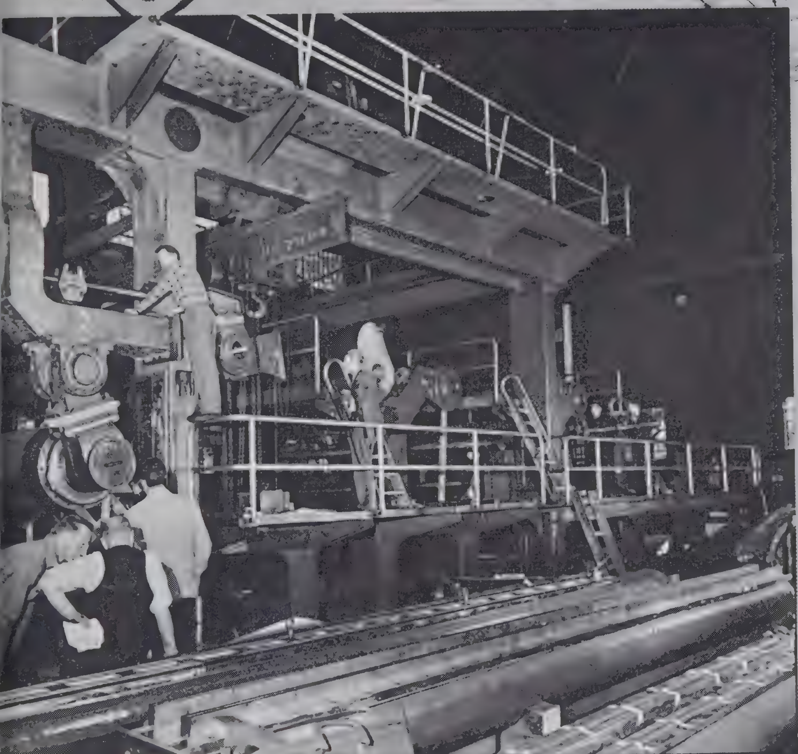
Les principaux domaines de travail des techniciens comprennent la recherche, le dessin de modèles et le perfectionnement, la fabrication des appareils et le fonctionnement d'un service aérien.

En recherche et perfectionnement, les techniciens sont en quête de nouveaux matériaux et de nouvelles méthodes pour accroître la vitesse et la capacité de transport. Ils analysent les épreuves de vol, contrôlent les poids, déterminent les efforts, recherchent au moyen du tunnel aérodynamique l'action de courants d'air sur les formes, se livrent à des épreuves de structures et de vibrations et à des essais de rendement des moteurs et de leurs organes. Les engins spatiaux, tels que la fusée *Black Brant* de recherche en haute altitude et le satellite *Alouette,* sont l'objet d'expériences et de perfectionnements auxquels collaborent les techniciens.

Les techniciens de recherche et de perfectionnement travaillent dans des salles d'essais, des laboratoires et des bureaux de dessin de modèles, propres et bien éclairés. Les locaux où s'effectuent les recherches en tunnel aérodynamique et les essais de moteurs sont nécessairement bruyants. Certains techniciens remplissent les fonctions de dessinateurs et exécutent rarement des travaux exigeant un effort physique, tandis que d'autres, par exemple ceux qui travaillent dans des cellules d'essai de moteurs ou à des programmes d'épreuves de vol, mènent une vie intense.

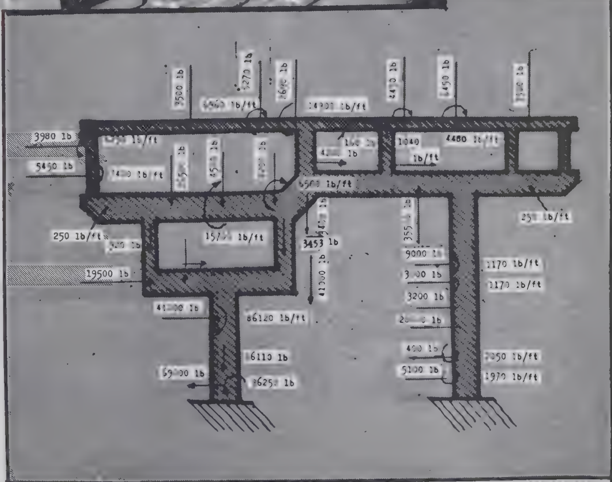
La fabrication des avions comprend plusieurs branches: moteurs, cellules, montage d'appareils et de dispositifs, inspection, etc. Les techniciens concourent à l'application des principes du génie, à la solution de problèmes de construction, de mise au point et de modification. Ils préparent les esquisses et les épures, agissent en qualité d'agents de liaison entre la salle des études et les diverses branches de la production, s'occupent du contrôle de la qualité, de l'organisation de la production, de la conception d'outils.





Techniciens occupés au montage d'un bâti de presse

Il a fallu résoudre plus de 100 équations avant d'aplanir les difficultés que posaient les articulations rigides de ce bâti (voir dessin à droite).



TECHNOLOGIE DE LA MÉCANIQUE

Étant donné qu'à peu près toutes les industries utilisent des machines, la technologie de la mécanique constitue la base même d'un grand nombre de procédés industriels et se fusionne dans une certaine mesure avec d'autres technologies. Par exemple, elle fournit les machines et l'outillage nécessaires pour les travaux d'électricité et de génie civil.

Il existe plusieurs domaines principaux de spécialisation, chacun si vaste que les techniciens devront se spécialiser dans l'une des divisions ci-après:

Génératrices d'énergie—machines à vapeur; moteurs diesels et autres moteurs à combustion interne; moteurs actionnés par l'énergie marémotrice; aéromoteurs; turbines hydrauliques ou turbines à gaz.

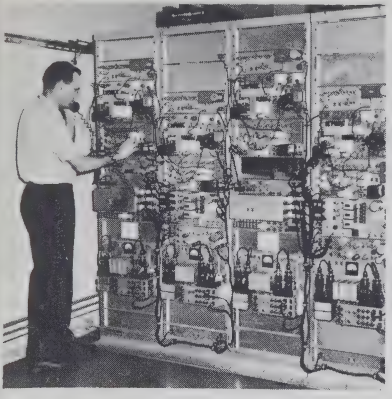
Appareils de transmission d'énergie et de manutention—convoyeurs, engrenages, arbres de transmission et appareils de transmission de la chaleur.

Moteurs et appareils utilisant de l'énergie—machines-outils, ventilateurs et appareils divers; fours industriels; automobiles, locomotives, avions et navires.

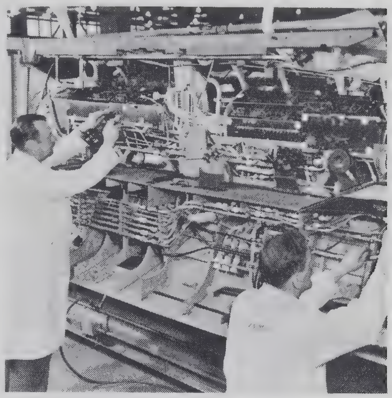
Climatisation—chauffage, ventilation et réfrigération.

Les techniciens doués surtout pour la mécanique et l'organisation occupent des postes de chefs de services, contremaîtres d'installations, organisateurs de la production et analystes de détails. Ceux qui ont du talent pour le dessin expriment des idées créatrices sous forme d'épures. Avec du goût pour les mathématiques et les sciences, ils peuvent être appelés à résoudre des problèmes d'ordre technique concernant les engrenages, la lubrification, les coussinets, les formes et les structures. D'autres encore sont occupés à l'entretien, à la vérification et au fonctionnement

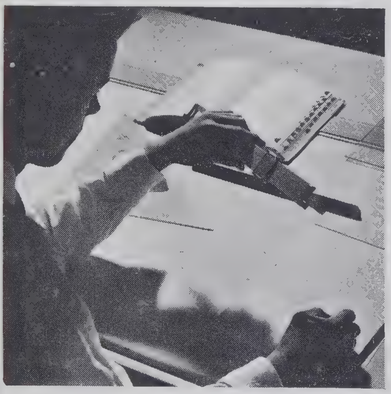
Outre ses connaissances théoriques, le futur technicien doit avoir un esprit curieux non seulement pour découvrir comment fonctionne un mécanisme, mais aussi pour en améliorer le fonctionnement. La dextérité et l'initiative pour faire face aux situations imprévues constituent de précieuses qualités.



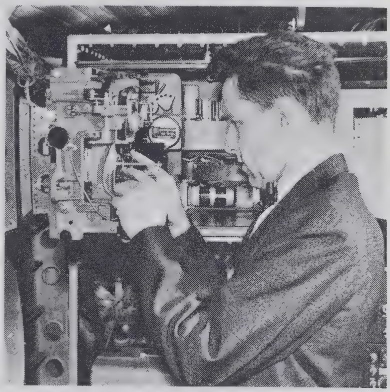
Épreuve de matériel pour micro-ondes



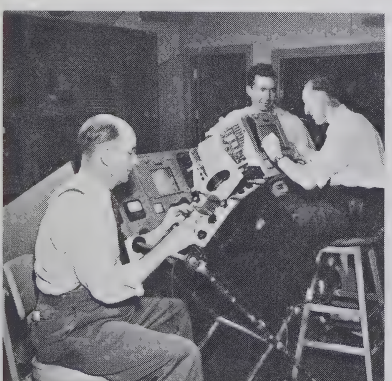
Montage des canalisations électriques d'un aéronef



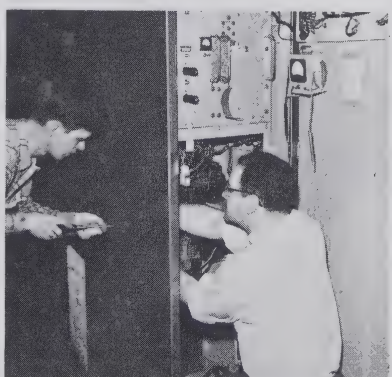
Dessinateur-projeteur au travail



Le matériel militaire doit répondre à des normes rigoureuses.



Le technicien localise les défauts de fonctionnement.



Le montage d'un émetteur de télévision est facile pour le technicien qualifié.

fabrication et participent à la création des modèles. Les opérations diverses que comprennent le dessin et la fabrication des tubes, depuis le tube de réception radiophonique jusqu'aux tubes répondant à des buts particuliers,—klystrons, magnétrons et tubes à rayons cathodiques,—sont autant d'autres domaines d'activité.

Les entreprises industrielles modernes telles que les raffineries de pétrole, les fabriques de produits chimiques, les aciéries et les papeteries disposent d'un appareillage comprenant habituellement des intruments électroniques de mesure, d'indication et de commande dans différents procédés de fabrication.

Le grand nombre de tâches et fonctions diverses exigent l'application de connaissances théoriques et pratiques appropriées. Les techniciens occupés à établir les conditions des épreuves, à organiser ces épreuves et à concevoir le dessin du modèle des appareils utilisés dans les épreuves doivent posséder des connaissances étendues en électricité et en électronique. Les travaux d'épreuve et de vérification exigent surtout l'aptitude à se servir d'instruments tels que les oscilloscopes, générateurs de signaux, ohmmètres, dispositifs de connexion pour tous courants et appareils de contrôle de courant à haute tension; il faut aussi avoir acquis les connaissances théoriques suffisantes pour interpréter, analyser et calculer les relevés des appareils de contrôle. Les techniciens préposés à la réparation et à l'entretien exécutent leurs travaux à l'aide d'outils tels que tournevis, clefs, pinces et fers à souder, besognes qui n'exigent, en général, que peu de connaissances théoriques et mathématiques.

Toutefois, tous les techniciens en électrotechnique et en électronique doivent posséder certaines qualités primordiales: l'amour de l'étude et un intérêt réel dans leur travail. Parmi les technologies, celle de l'électricité évolue le plus rapidement. La plupart des innovations importantes ont été réalisées au cours des vingt dernières années; les dix prochaines années en apporteront d'autres, imprévisibles aujourd'hui. Les techniciens se doivent donc de continuer à s'instruire et à se tenir au courant des derniers progrès.

Pour obtenir de plus amples renseignements sur la production d'énergie, les télécommunications et la radiodiffusion, on peut se procurer la brochure de la même série: TRAVAILLEURS DE L'ÉLECTRICITÉ ET DE L'ÉLECTRONIQUE.

les ultra-sons,—le nettoyage des instruments, par exemple,—le chauffage au moyen de courants électriques de haute fréquence ou, dans le domaine médical, les appareils de diathermie et de radiographie.

Le vaste domaine de l'électronique peut être considéré comme la branche de l'électricité qui utilise des dispositifs telles que tubes et semi-conducteurs (transistrons). Ses applications les plus connues concernent la radio, la télévision et autres formes de communications. On utilise également l'électronique dans l'industrie, le commerce et la défense.

Les secteurs d'emploi y sont nombreux: fabrication d'appareils; instruments enregistreurs, instruments de mesure, appareils de commande et de signalisation; systèmes, civils ou militaires, de téléguidage et de navigation automatique; télécommunications. L'enregistrement de messages, de statistiques et d'inventaires s'effectue de plus en plus au moyen d'ordinateurs qui, comme les commandes automatiques (automatisation), ne sauraient fonctionner sans tube ou semi-conducteur électronique. Il ne faudrait pas perdre de vue l'importance que prend l'électronique dans d'autres domaines: le cardioscope et le microscope électroniques en médecine et en sciences, le cyclotron et le bétatron en énergie atomique, le télescope électronique en astronomie.

Les secteurs de l'industrie manufacturière qui offrent le plus de possibilités d'emploi sont sans aucun doute les suivants: matériel militaire et civil, biens de consommation, tubes et semi-conducteurs électroniques, outillages divers.

Le matériel militaire et civil comprend les instruments et le matériel nécessaires aux systèmes de téléguidage et de détection, les commandes automatiques et les machines à calculer, dont les services de l'État font un ample usage. Le ministère de la Défense nationale, par exemple, emploie des électroniciens pour l'entretien et le fonctionnement de la ligne avancée de pré-alerte (DEW Line); le ministère des Transports, pour l'entretien et le fonctionnement des systèmes de télécommunications et de radionavigation: radar, Loran, appareils d'atterrissage, si utiles à la navigation aérienne et maritime; et les Forces armées, dans un bon nombre de services.

Les biens de consommation comprennent, entre autres, les téléviseurs, les postes de radio, les appareils à haute fidélité et les appareils auditifs. Des techniciens sont employés à la mise au point et aux épreuves de ces appareils; ils en surveillent la

CHAMPS D'ACTION

Où les techniciens travaillent-ils? Dans tous les domaines d'activité scientifique et technique, on trouve des techniciens qui occupent des postes importants. De fait, ces champs d'action sont si nombreux que nous devons nous limiter, dans cette modeste brochure, à quelques-uns d'entre eux. Nous avons donc choisi ceux pour lesquels des cours sont donnés dans des instituts de technologie ou aux fins desquels la formation peut s'acquérir par des moyens bien déterminés.

TECHNOLOGIE DE L'ÉLECTRICITÉ

La technologie de l'électricité offre deux grands domaines d'emploi,—l'énergie électrique et l'électronique,—qui comportent cependant un certain nombre de divisions. Ainsi, l'électronicien peut, par exemple, être occupé dans la division des communications, mais être spécialisé dans une subdivision telle que la télévision ou la téléphonie.

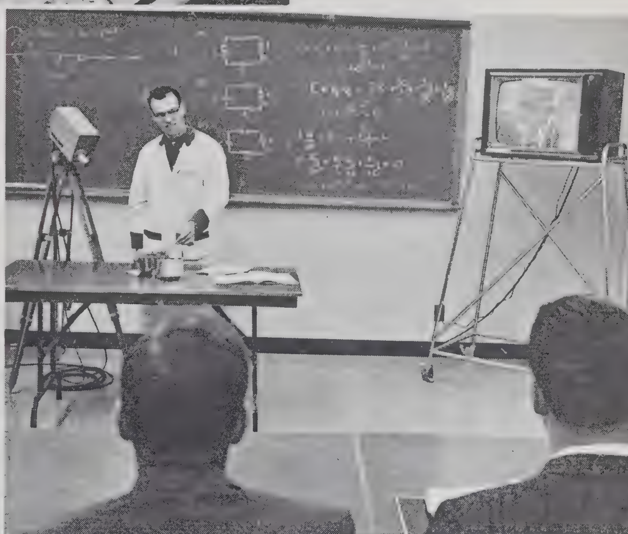
Quelle que soit la division, les techniciens appliqueront leurs connaissances théoriques et pratiques à une ou plusieurs des fonctions exposées au chapitre *Nature du travail.* Toutefois, la division dans laquelle ils se sont spécialisés et dont les grandes lignes sont données ci-dessous détermine leur tâche précise.

Dans les centrales et les sous-centrales électriques, les techniciens veillent au fonctionnement des installations et à la répartition de la charge. Ils peuvent être appelés à vérifier, inspecter et entretenir des génératrices, moteurs, transformateurs, commandes automatiques et autres appareils similaires.

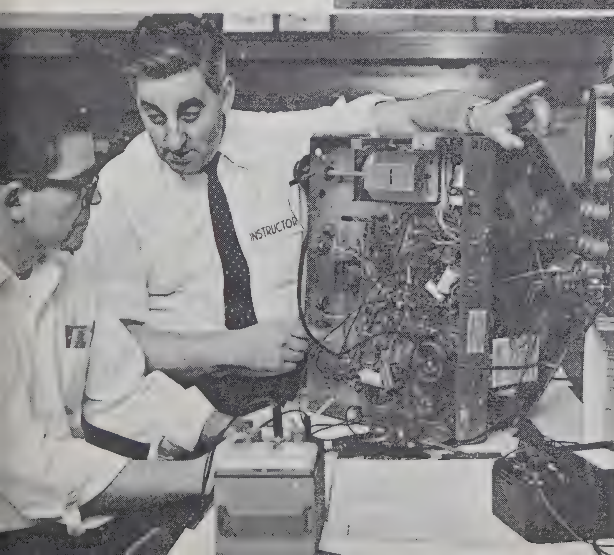
Dans la fabrication, les techniciens aident à la création du modèle et à l'essai de produits très variés, depuis les grosses génératrices de centrale électrique jusqu'aux petits appareils ménagers. Ils aident à résoudre les problèmes relatifs aux produits de la compagnie: amélioration du rendement ou réduction des dimensions d'un appareil. Ils surveillent le processus de fabrication et effectuent des travaux inhabituels de vérification et d'inspection.

Dans les fabriques, les hôpitaux, les hôtels et autres grands immeubles, ils surveillent la mise en place des installations électriques, inspectent ces installations afin de s'assurer qu'elles sont conformes aux codes local et fédéral d'électricité et, au besoin, s'occupent de travaux d'entretien et de réparations. D'autres encore sont occupés dans des branches spécialisées telles que

L'étudiant apprend la technique d'atelier à l'école de formation professionnelle.



Dans un bon nombre de sociétés canadiennes, la formation est confiée à des instructeurs.



L'instructeur explique l'application pratique des théories.

ENSEIGNEMENT

Dans l'industrie, le lancement de produits nouveaux ou améliorés entraîne souvent des changements de techniques nécessitant parfois la rééducation des travailleurs. Bien souvent, on confie cette tâche à des techniciens employés en qualité d'instructeurs à à temps partiel ou à plein temps. L'enseignement varie sensiblement, depuis les périodes d'instruction dans des ateliers de compagnies jusqu'aux cours à plein temps dans des salles de classe pourvues de tout l'outillage moderne.

Dans les écoles de formation professionnelle et de métiers, les professeurs doivent connaître à fond le métier qu'ils enseignent et, de plus, posséder les connaissances générales requises dans les matières classiques. C'est pourquoi l'enseignement y est souvent dispensé par des techniciens et des ouvriers spécialisés provenant de l'industrie. Les écoles publiques exigent de leurs professeurs un brevet d'enseignement qu'ils peuvent obtenir en suivant des cours d'été ou des cours du jour à plein temps, d'une durée de six à huit mois.

En plus de bien connaître les techniques qu'ils enseignent, professeurs et instructeurs doivent posséder l'aptitude à transmettre leurs connaissances et le désir sincère d'aider les autres. L'aptitude à diriger,—qualité indéfinissable qui inspire le respect,—est essentielle au maintien de la discipline en classe. Une mise soignée, une bonne apparence et une voix agréable sont également des qualités souhaitables.

Pour obtenir de plus amples renseignements sur l'enseignement, on peut se procurer la brochure de la même série: l'INSTITUTEUR.

VENTE D'OUTILLAGE TECHNIQUE ET SERVICE

De vastes possibilités d'emploi s'ouvrent aux vendeurs chargés de s'enquérir des besoins en matériel technique de clients en perspective, d'examiner les moyens propres à les satisfaire et de fournir à leur patron les données techniques qui pourront servir à établir les modèles et les estimés.

On recherche de plus en plus des techniciens d'une grande sociabilité et possédant les connaissances techniques permettant de résoudre les différents problèmes de leurs clients. Ces techniciens doivent être capables de discuter du fonctionnement, de modifications, de réparations et d'entretien des machines et appareils déjà installés aussi bien que des machines et appareils qu'ils cherchent à fournir.

Comme les vendeurs doivent être aptes à s'entretenir et à s'entendre avec des personnes de genres différents, réussiront le mieux ceux qui sauront joindre la compétence technique à une personnalité agréable, mais forte, et dont la mise, les manières et la conversation impressionneront favorablement.

Publications techniques

C'est au directeur des publications techniques, appartenant souvent à la division des ventes et du service d'outillage technique, qu'il incombe de mettre au point les publications techniques. Il dispose d'un personnel de rédacteurs techniques et de dessinateurs chargés de recueillir les renseignements et d'exécuter les illustrations des manuels d'instruction, de fonctionnement, d'entretien et de pièces de rechange. Ces manuels sont préparés à l'aide de dessins, de descriptions et d'après les connaissances que possèdent les rédacteurs sur les produits que fabrique la compagnie.

L'aptitude à rédiger clairement, avec concision et précision, des publications de caractère technique constitue une très grande qualité qu'on exige des rédacteurs techniques. Ceux-ci doivent également pouvoir discuter de certains problèmes avec des travailleurs appartenant à tous les niveaux, posséder une bonne mémoire, de l'initiative et de l'ingéniosité.

Les dessinateurs doivent avoir suffisamment d'esprit inventif pour établir des projections perspectives, axonométriques et autres du même genre, d'après des dessins mécaniques. La précision et certaines connaissances en mathématiques s'imposent car, à l'encontre des dessins artistiques, les dessins industriels doivent être établis à l'échelle. Il est bon également de connaître l'imprimerie et autres modes de reproduction.

du travail de façon que la main-d'œuvre et les machines soient utilisées au maximum et le plus économiquement possible, que les matières et matériaux soient livrés en temps voulu. Voici quelques-unes des fonctions remplies par des techniciens:

L'*organisateur de la production* étudie les dessins de modèles afin de fixer la marche des travaux et choisir l'outillage, les machines-outils, et les ouvriers spécialisés nécessaires à la production.

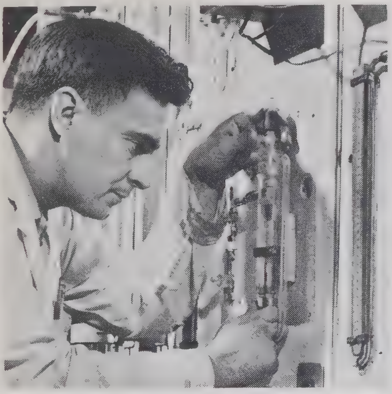
Les *dessinateurs-projeteurs et les dessinateurs d'outillage* dans les usines créent des modèles de matrices, accessoires et outils appropriés à la production en tenant compte de facteurs tels que les matériaux utilisés, leur résistance, les tolérances et le jeu permis.

Les *évaluateurs et les chronométreurs analystes* constituent un autre groupe de techniciens; ils veillent, par une analyse et une étude soignées des détails, à ce que les travaux se succèdent dans l'ordre prévu et le plus économiquement possible. L'approvisionnement en matières premières et autres fournitures reste du domaine des acheteurs mandataires, acheteurs, agents préposés à la prévision des besoins, et leurs aides administratifs.

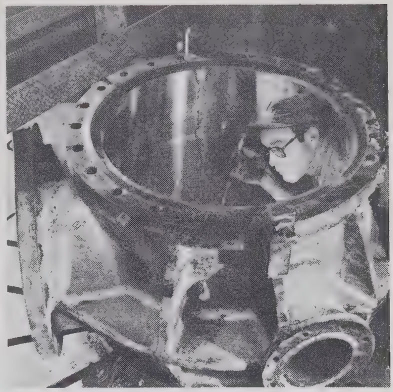
Planifier la production exige la maîtrise de ses techniques; c'est pourquoi beaucoup de postes de techniciens sont actuellement occupés par des ouvriers hautement qualifiés. Les nombreux problèmes que pose la production exigent une compréhension de la mesure des temps et mouvements, du contrôle statistique, de la recherche fonctionnelle et même la connaissance des machines calculatrices.

Ce travail s'effectue dans les bureaux, mais il exige de fréquentes visites aux différentes branches de la production, où règnent le bruit, la chaleur, etc.

Les qualités personnelles les plus importantes sont la précision, l'esprit de recherche, le tact et l'aptitude à travailler sous pression. Le tact devient nécessaire pour déterminer les normes applicables aux ouvriers et fixer des dates de livraison aux clients; les techniciens doivent toujours rechercher les moyens propres à augmenter la production; l'aptitude à travailler efficacement sous pression permet d'éviter les retards dans la production.

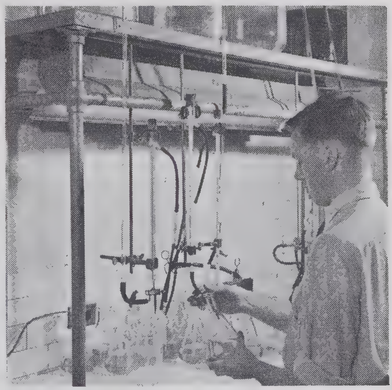


Analyse qualitative d'un échantillon de pétrole raffiné

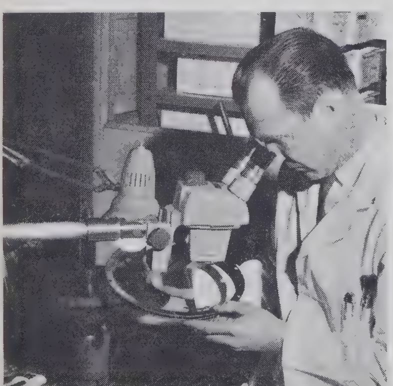


Examen d'une soupape de lessiveur (fabrication du papier)

Vérification dimensionnelle sur les ailettes de la turbine d'un moteur à réaction



Titrage d'une distillation de grains pour en déterminer la teneur en protéine



Examen visant à déterminer la cause de la défaillance d'un joint d'étanchéité d'un moteur à réaction

L'inspection joue un rôle important dans le conditionnement des produits alimentaires.

Le contrôle de la qualité est habituellement du ressort du chimiste, de l'architecte ou de l'ingénieur. Les épreuves, faites par les techniciens, exigent l'emploi de dispositifs de mesure électroniques ou autres. L'inspection est plutôt un travail de routine comportant des examens visuels ou des vérifications à l'aide d'outils mécaniques tels que des micromètres, des règles et des jauges.

Les matériaux à éprouver et à vérifier varient suivant l'industrie qui les utilise. Il peut s'agir de déterminer la viscosité d'une huile ou la résistance et la qualité du papier; de visiter un immeuble pour s'assurer qu'il satisfait aux règlements; de vérifier des véhicules au point de vue sécurité.

Les salles de contrôle de la qualité, les salles d'observation et les laboratoires d'essai sont habituellement silencieux et bien éclairés. Lorsqu'il s'agit de vérification au cours de l'exécution des travaux, les techniciens ont à subir les conditions d'une industrie particulière: la température élevée d'une fonderie; la pluie ou le froid, dans la construction; le bruit des avions à réaction dans l'industrie aéronautique.

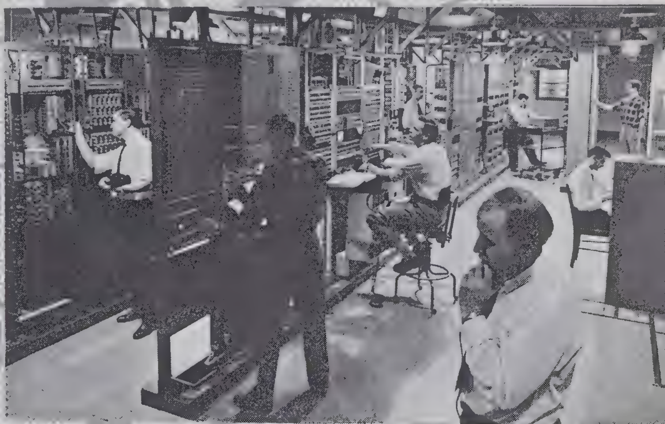
La confiance dans leurs connaissances et leur jugement, l'aptitude à prendre des décisions réfléchies représentent des qualités personnelles importantes. Lorsqu'il s'agit de rejeter des pièces défectueuses, l'intégrité, la fermeté de caractère et l'entregent sont essentiels.

ORGANISATION DE LA PRODUCTION

Qu'il s'agisse de la construction d'un immeuble ou de la fabrication d'articles en série, l'organisation est essentielle, car elle assure une disposition ordonnée de l'outillage de l'établissement, l'achat et l'utilisation de matériaux appropriés ainsi que l'utilisation rationnelle du personnel de la production.

Des équipes d'organisateurs de la production veillent à ce que le travail s'accomplisse suivant un plan d'ensemble. L'industrie manufacturière emploie de nombreux techniciens spécialisés dans ce genre de travail. Dans la construction, on ordonne les phases

la station, les répartiteurs
glent le débit.



echniciens occupés au fonc-
onnement du matériel élec-
onique à un centre de com-
unication de la ligne mid-
anada

ant en radio qu'en télévision,
es techniciens s'occupent du
onctionnement et de l'entretien
es appareils émetteurs.

FONCTIONNEMENT ET ENTRETIEN

Des groupes de techniciens s'occupent du fonctionnement et de l'entretien d'installations telles que les réseaux de télécommunications, les stations de radio et de télévision, les services publics d'électricité et les raffineries de pétrole.

Leur principale fonction consiste à veiller à la manœuvre correcte des appareils. Ce travail offre parfois l'occasion au technicien de perfectionner les appareils, de faire preuve d'ingéniosité dans certaines circonstances ou devant certaines exigences, et comprend souvent la réparation ou remise en état des machines, ainsi que la mise en marche d'installations nouvelles.

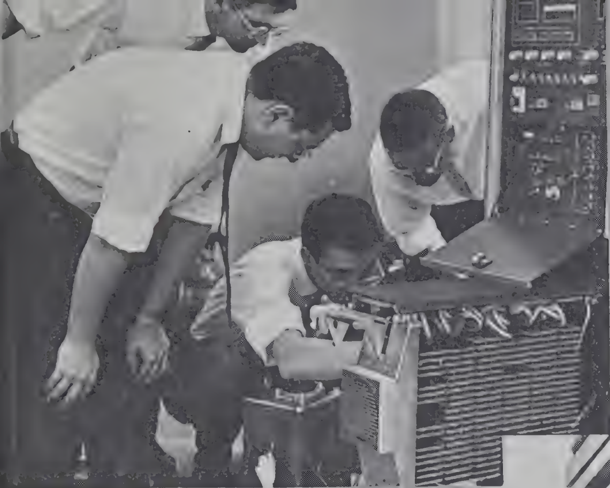
Il existe d'autres fonctions, celle de mécanicien de machines fixes par exemple, pour lesquelles les instituts de technologie donnent des cours. Les règlements provinciaux exigent que les mécaniciens obtiennent un certificat avant de pouvoir assumer la responsabilité d'une centrale d'énergie. Les mécaniciens ont la charge et assurent le bon fonctionnement de machines à vapeur, de compresseurs et autres machines utilisés dans les hôpitaux, immeubles de bureaux et autres grands édifices publics et commerciaux, ainsi que dans des établissements industriels tels que les centrales thermiques ou électriques.

INSPECTION

La complexité croissante de nombreux matériaux et procédés s'ajoutant à la demande de produits et de services toujours meilleurs, le contrôle de la qualité revêt une grande importance à tous les stades de la fabrication et de la construction. Il s'échelonne de l'examen des matières brutes à l'épreuve et au fonctionnement du produit fini en passant par de nombreuses phases intermédiaires.

Les travaux d'inspection portent, dans l'ensemble, sur le contrôle de la qualité, les épreuves et la vérification; ils exigent donc les services de différents spécialistes.

Pour obtenir de plus amples renseignements sur le fonctionnement des installations, y compris la production de l'énergie, les télécommunications et la radiodiffusion, on peut se procurer la brochure de la même série: TRAVAILLEURS DE L'ÉLECTRICITÉ ET DE L'ÉLECTRONIQUE.



Travaux de montage—

Ci-dessus:

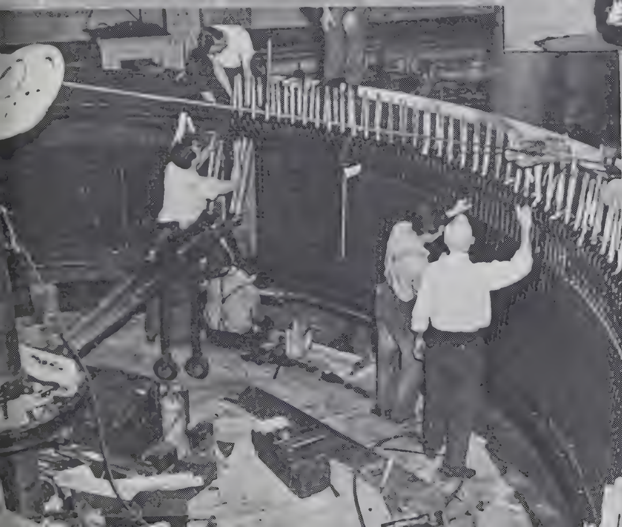
Les fabricants de machines de bureau se chargent du montage des calculatrices et des ordinateurs.

Ci-contre:

Vérification d'une nouvelle installation à la centrale téléphonique de l'Alberta Government Telephones

Ci-dessous:

Montage d'une génératrice de 18,500 KVA dans une station génératrice d'énergie hydro-électrique



Le dessin industriel est un travail sédentaire où l'effort physique est minime, mais qui exige une excellente acuité visuelle, du soin dans l'exécution, l'aptitude à représenter la pièce à dessiner et aussi les rapports de cette pièce avec les autres dans le produit fini.

L'équipe comprend également des techniciens pour la mise au point; ils exécutent des modèles pratiques, des installations d'essai, des prototypes afin de procéder aux épreuves ou de déterminer les normes de production. Souvent très versés dans le métier, parfaitement au courant des machines et des procédés industriels, ces techniciens peuvent être employés à la conversion des résultats des essais en données mathématiques.

D'autres techniciens encore agissent comme agents de liaison entre les salles de dessin et les diverses branches de la production. Ils vérifient les dessins afin de relever les erreurs possibles, acceptent des changements proposés dans les matériaux ou les procédés à utiliser et, dans l'ensemble, assurent des relations harmonieuses entre les équipes qui ont conçu le produit et celles qui le fabriquent.*

INSTALLATION

Bien souvent, les compagnies de téléphone et d'électricité, les fabricants d'appareils de climatisation, de calculatrices électroniques et de machines de bureau installent elles-mêmes leurs appareils chez les clients. C'est un travail exigeant des équipes de techniciens et d'ouvriers qualifiés bien que les grandes entreprises confient souvent la surveillance des travaux à un ingénieur.

Les techniciens mettent en marche les machines, assurent leur bon fonctionnement, décèlent les défectuosités et y remédient. Les machines installées, on demande souvent aux techniciens d'en apprendre l'utilisation aux employés du client et, par la suite, de procéder à une inspection périodique de ces machines.

Les qualités personnelles du technicien incluent une mise soignée et de bonnes habitudes de travail, une affabilité propice aux bonnes relations avec la clientèle, l'application et le souci des détails afin que les machines fonctionnent avec le minimum d'inconvénients pour le client.

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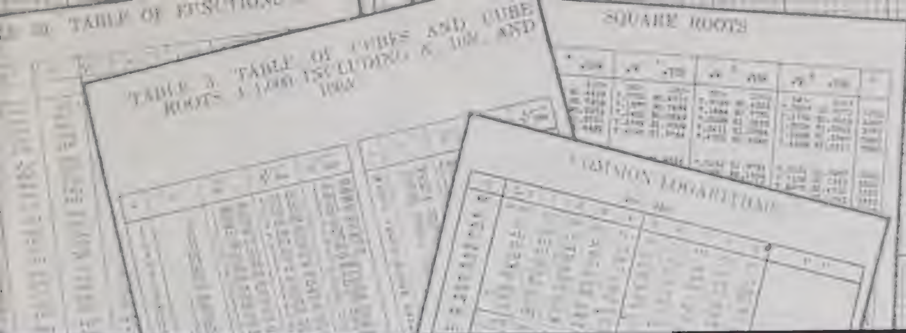
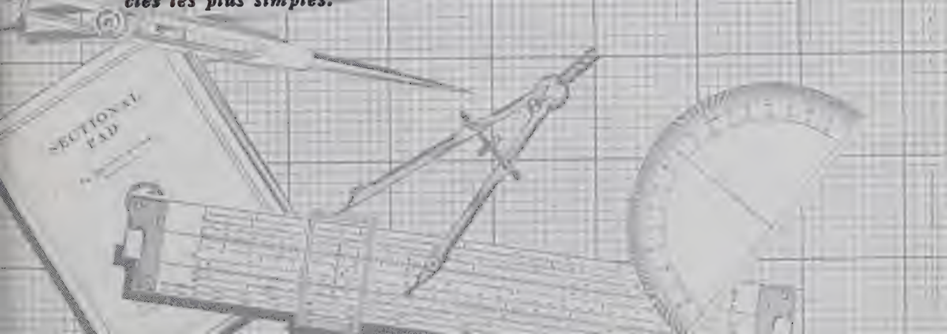
* Pour obtenir de plus amples renseignements, on pourra se procurer la brochure de la même série: CARRIÈRES DANS LE DESSIN.



C'est à la table à dessin, où servent les connaissances de la géométrie, de la trigonométrie et du calcul infinitésimal, que sont établis les dessins des structures les plus compliquées et des articles les plus simples.



CONCEPTION ET EXÉCUTION

Les équipes travaillant dans ces domaines s'attaquent aux problèmes que posent la production de nouveaux outils, produits et services ou le perfectionnement de ceux qui existent déjà.

Il appartient au chercheur (architecte, ingénieur, scientifique ou autre) d'imaginer un nouveau service, d'inventer un produit et de concrétiser ses idées par des plans. La partie de la tâche confiée aux techniciens se limite ordinairement aux multiples détails de fabrication du produit ouvré.* Lorsqu'il s'agit d'amélioration de produits, les techniciens suivent des techniques établies,—devis descriptifs, normes et autres données techniques,—et préparent de nouveaux modèles en se fondant sur des normes courantes.

Les dessinateurs forment le groupe numériquement le plus important de ces équipes; ils fournissent les dessins, les instructions générales sur le montage et l'installation et d'autres renseignements similaires sur lesquels les travailleurs à la production se guideront pour fabriquer les produits ou fournir les services. Ils doivent posséder non seulement une connaissance suffisante des techniques du dessin, mais encore une solide formation dans leur technologie particulière. En électronique, par exemple, le dessinateur doit avoir des connaissances de physique sur la production, la propagation et l'amplification des ondes électromagnétiques.

Les dessinateurs de la construction mécanique calculent non seulement les dimensions d'un objet mais aussi le poids, la résistance et certaines particularités telles que le rapport de démultiplication d'engrenages. Lorsqu'ils établissent les plans de machines et d'autres mécanismes, il leur faut avoir une certaine connaissance de la physique, des mathématiques et des propriétés des métaux.

Les dessinateurs en bâtiment doivent connaître dans une certaine mesure les matériaux de construction, la théorie des charpentes, les devis descriptifs et les contrats, posséder une formation mathématique suffisante pour effectuer des calculs sur la construction des charpentes métalliques et en béton armé.

* Cette limitation s'applique tout particulièrement dans certaines branches du génie. L'expression «création de modèles», employée ici pour définir le travail du technicien, ne s'applique qu'aux travaux mentionnés dans cette brochure et non aux travaux de création de modèles que, suivant la législation provinciale, seul un membre d'une association d'ingénieurs professionnels peut entreprendre.

RECHERCHE

Les équipes de chercheurs s'appuient sur les services de nombreux techniciens et sur la collaboration entre les scientifiques, tels que les métallurgistes et les chimistes, et les ingénieurs.

Les fonctions des techniciens sont nombreuses et diverses. Elles s'échelonnent depuis celles qui exigent la connaissance de techniques compliquées, fondée sur des bases théoriques appropriées, jusqu'aux travaux de routine, en passant par une foule de tâches intermédiaires.

En général, les techniciens sont les assistants des scientifiques dans la mise en œuvre de programmes d'expérimentation soignés et réfléchis. Plus particulièrement, ils aident à dessiner, à fabriquer et à faire fonctionner des appareils spéciaux d'essai tels que les instruments de mesure de la tension et du mouvement, ainsi que d'autres dispositifs employés dans les technologies du bâtiment, de la mécanique et de l'aéronautique. D'autres mettent à profit leurs connaissances en mathématiques et en sciences aux fins d'analyse de données d'épreuves.

D'autres, comme techniciens de laboratoires de physique ou de biologie, marquent, mesurent et pèsent les échantillons ou travaillent avec des chimistes à des analyses qualitatives et quantitatives. Ces analyses portent, entre autres, sur les métaux, la viscosité des huiles, la structure des fibres textiles et la composition des sols. Les aides de laboratoire, d'autre part, s'emploient à des travaux qui, tout en gardant un caractère technique, sont plutôt routiniers; ils en consignent les résultats sous forme de graphiques et de diagrammes.

La plupart des recherches s'effectuent dans des laboratoires très différents selon l'industrie et l'importance que celle-ci attache aux recherches. Certains laboratoires sont propres et bien éclairés, alors que d'autres peuvent être encombrés d'appareils. L'application de méthodes sûres et reconnues réduit au minimum le danger que comporte la manipulation de produits chimiques, radioactifs et de substances similaires.

Le technicien doit non seulement posséder les connaissances requises, mais encore faire preuve de patience et de ténacité,—il lui faudra, peut-être, procéder à des milliers d'expériences dont aucune n'est superflue, avant d'aboutir à des résultats tangibles. A ces qualités s'ajoutent l'initiative et l'ingéniosité pour être en mesure de fabriquer et de faire fonctionner des appareils d'essai parfois différents de tout ce qui a pu être déjà construit ou fabriqué.

qu'intermédiaires entre les professionnels et les contremaîtres et ouvriers. Les instituts provinciaux de technologie assurent la formation des techniciens. Les programmes d'études des instituts revêtent habituellement un caractère plus technique que ceux des universités, bien que les deux portent sur les mêmes domaines généraux. En outre, la formation peut également être spécialisée pour répondre aux besoins d'une industrie particulière,—papeterie, filature, mines, etc.,—dans une région déterminée.

Les ouvriers spécialisés et autres travailleurs à la production acquièrent la formation nécessaire par un apprentissage ou par un entraînement. L'apprentissage comprend une formation sur place, sous la direction d'un ouvrier spécialisé et expérimenté, complétée par plusieurs semaines d'études théoriques au cours de chaque année de l'apprentissage. L'entraînement est similaire mais ne comprend généralement pas d'enseignement en classe.

Les connaissances théoriques diffèrent sensiblement selon qu'elles sont acquises à l'université ou à l'institut de technologie; de là la distinction entre le professionnel et le technicien. Ce dernier reçoit une formation pratique et n'acquiert que les connaissances théoriques suffisant à l'exercice de sa profession; mais il n'est pas nécessaire qu'il connaisse à fond la théorie. L'électronicien-inspecteur, par exemple, doit être en mesure de lire les instruments et de déceler les défectuosités, mais n'est pas tenu de posséder les vastes connaissances qui mèneront à la découverte de nouvelles théories de l'électronique,—c'est là le rôle du scientifique,—ou à la conception de nouveaux modèles d'émetteurs pour la radiodiffusion.

Ainsi, en vertu de la formation qu'ils ont reçue, les techniciens ont pour rôle principal de libérer les scientifiques et les ingénieurs de certaines tâches que ceux-ci, autrement, devraient accomplir. Ils servent ainsi d'intermédiaires entre les professionnels et les travailleurs à la production dans les domaines énumérés ci-dessous.

NATURE DU TRAVAIL

Que font les techniciens? Pour comprendre la nature du travail du technicien, il faut d'abord faire connaissance avec l'«équipe technique», connaître le rôle de chaque membre de l'équipe et savoir comment ils sont arrivés à leurs différents postes.

Au début du siècle, l'invention et la production constituaient deux domaines distincts ayant chacun ses attraits et ses problèmes particuliers. Les universités dispensaient la science; la production et la distribution relevaient du manufacturier. Les inventeurs, dit-on, vivaient solitaires dans des greniers ou des ateliers en sous-sol.

Tout cela a changé aujourd'hui. L'évolution technique,—biens plus complexes, modes de fabrication plus compliqués, automatisation et production massive,—a conduit au «travail d'équipe».

L'exploitation générale d'une société reste, dans une certaine mesure, l'affaire d'une seule grande équipe. De fait, cependant, le terme «équipe» désigne de petits groupes de spécialistes unis les uns aux autres par un objectif commun: recherche, création, production, etc.

Chaque équipe, abordant un problème sous un aspect particulier, se compose *grosso modo* de trois groupes: (1) les «professionnels» (architectes, ingénieurs et scientifiques tels que biologistes, chimistes et travailleurs assimilés), (2) les techniciens et (3) les ouvriers de métiers et autres travailleurs à la production. Ces groupes, de formation différente, jouent des rôles divers, mais connexes.

Traditionnellement, c'est à l'université que les «professionnels» acquièrent les vastes connaissances théoriques nécessaires au rôle qui leur incombe de formuler des idées nouvelles et d'organiser et diriger les équipes de techniciens.

Les techniciens, d'autre part, ont besoin de connaissances théoriques plus spécialisées et d'une formation pratique aux techniques compliquées qu'exige le rôle qu'ils ont à jouer en tant

L'industrialisation rapide du Canada après la guerre a modifié sensiblement la structure de l'emploi. Dans nos fabriques, dans nos bureaux et dans presque tous les secteurs des affaires et de l'industrie, un bon nombre de métiers séculaires sont en régression pour faire place à de nouveaux emplois.

Ce groupe a évolué si rapidement que les particularités et les noms des occupations manquent encore d'uniformité. Les travailleurs qui en font partie peuvent être désignés, selon l'industrie et souvent selon l'employeur, soit d'après le travail qu'ils exécutent (inspecteur ou analyste de matériau), soit d'après l'outillage qu'ils emploient (préposé aux calculs géophysiques ou technicien en radiographie). Au Québec, la législation reconnaît deux titres: technicien diplômé et technicien professionnel. Dans un bon nombre de provinces, certains titres, entre autres ceux de mécanicien de machines fixes et de mécanicien d'entretien d'avions, sont également reconnus par la législation. D'autre part, les travailleurs appelés techniciens dans l'industrie peuvent aussi bien être employés à de simples travaux de routine technique que se voir assigner des tâches qui s'apparentent à celles des ingénieurs et des scientifiques.

On étudie actuellement la possibilité d'établir des titres reconnus sur le plan interprovincial et probablement fondés sur les diplômes exigés dans chaque cas. Jusqu'à ce que ces titres soient effectivement fixés, toutefois, nous emploierons le terme commode de «technicien».

Les occupations techniques étudiées dans la présente brochure se ressemblent en ce que la théorie et la pratique essentielles à chacune d'elles doivent être apprises; elles ne peuvent être acquises exclusivement par l'expérience. *Le terme «technicien» s'appliquera donc à ceux qui occupent un poste exigeant des connaissances en physique, sur certains sujets de génie et en mathématiques, connaissances qui ne peuvent être acquises qu'au moyen d'un cours d'études particulières dans un institut de technologie, ou l'équivalent en études à temps partiel.*

Il est impossible, dans le cadre de la présente brochure, d'examiner tous les aspects d'un groupe si vaste d'occupations. Si vous désirez de plus amples informations sur une branche particulière de la technologie, nous vous recommandons de lire d'autres brochures de la même série (la liste figure à la deuxième page de la couverture) qui renseignent davantage sur certains domaines de travail.

LES TECHNICIENS EN SCIENCES ET EN GÉNIE

HISTORIQUE ET IMPORTANCE DE LA PROFESSION

Les maisons climatisées, les téléviseurs, les cuisinières et les machines à laver électriques, les tissus en fibres synthétiques de nos vêtements,—en un mot tout ce qui nous entoure,—indiquent que nous vivons dans une ère scientifique et technologique.

Les hommes de science s'efforcent de découvrir des lois et principes nouveaux qu'appliquent les ingénieurs, en vue de nous procurer une foule de biens et de services encore inconnus au début du siècle.

Les travaux des hommes de science et des ingénieurs retiennent l'attention alors que, bien souvent, les contributions essentielles d'autres travailleurs passent inaperçues. Les découvertes scientifiques, les réalisations techniques et, de fait, tout ce qui contribue à accroître notre bien-être matériel, exigent les services d'une foule de personnes dont la compétence, les connaissances et l'expérience sont des plus différentes et variées. La présente brochure est consacrée à un groupe particulier, celui des TECHNICIENS EN SCIENCES ET EN GÉNIE, qui joue un rôle important lorsqu'il s'agit de convertir des idées scientifiques et techniques en produits et services utilisables.

Le mot «technicien» est peut-être nouveau pour vous. C'est au cours de la révolution industrielle du milieu du 18e siècle qu'on a commencé à l'employer. Le dictionnaire, qui le mentionne pour la première fois en 1833, en donne la définition suivante: «personne qui connaît, applique ou fait appliquer la technique d'une science, d'un art, d'un métier». Ce n'est toutefois qu'en notre ère de transformation technologique que l'importance du technicien est enfin reconnue.

Le 20e siècle, en raison du progrès extraordinaire qu'il a apporté dans les domaines scientifique et technique, marque l'avènement d'un nouveau mode de vie. Nous sommes à l'âge de l'énergie atomique, des voyages interplanétaires, de la production massive et de l'automatisation. Ce progrès a occasionné des changements importants dans l'emploi, particulièrement en ce qui touche les techniciens. La construction d'un gratte-ciel, l'aménagement d'un emplacement de missiles ou le fonctionnement d'une entreprise qui fabrique des centaines de produits divers destinés à des milliers de clients exigent les services de spécialistes, dont nos techniciens, qui doivent connaître à fond la théorie et la pratique de leur spécialité.

LES TECHNICIENS EN SCIENCES ET EN GÉNIE

TABLE DES MATIÈRES

Photo de couverture:

Des techniciens du Conseil de recherches pour la défense apprêtent un satellite «Topside Sounder» en vue d'essais sur les facteurs ambiants. Les centaines de cellules solaires noires qui assurent l'énergie du satellite sont vérifiées à la chaleur qui se dégage des ampoules électriques.

AVANT-PROPOS

Depuis quelques années, la demande de renseignements sur les occupations au Canada augmente constamment. Cette demande vient de jeunes qui doivent se choisir une carrière et s'y préparer; elle vient aussi de parents, d'instituteurs et d'orienteurs, de travailleurs qui désirent changer d'emploi, de fonctionnaires du Service de placement, de directeurs de personnel, de dirigeants syndicaux, d'immigrants éventuels et de divers autres milieux.

La série de monographies intitulée *Occupations au Canada* a pour but d'aider à répondre à cette demande. Chaque brochure décrit, entre autres choses, la nature d'une occupation ou d'un groupe d'occupations, les conditions d'admission et de formation, les conditions de travail et les perspectives d'emploi.

La série a été préparée avec le généreux concours de représentants du patronat, de syndicats ouvriers et d'associations professionnelles. Il y a lieu de mentionner également la bienveillante collaboration de la Commission d'assurance-chômage, de la Direction de la formation professionnelle et technique du ministère du Travail et du Bureau fédéral de la statistique.

Les renseignements concernant les occupations ont tendance à devenir désuets à cause des changements qui se produisent dans les conditions économiques, dans la technologie industrielle et dans la structure des salaires et des traitements. On s'emploie constamment à remettre à jour les publications de la série qui ont perdu de leur actualité.

La présente brochure a été préparée et rédigée pour la Division des ressources en effectifs de main-d'œuvre par M. William Coe, sous la direction de M. William Allison, chef de la Section de l'analyse des occupations.

La Direction est redevable aux nombreuses organisations et sociétés dont la collaboration a rendu possible la publication de la présente monographie.

Le directeur de l'économique
et des recherches,
Ministère du Travail,
J. P. FRANCIS

Janvier 1963

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LES TECHNICIENS EN SCIENCES ET EN GÉNIE

Préparée
par la
Direction de l'économique et des recherches
du
ministère du Travail, Canada

L'HON. ALLAN J. MacEACHEN
ministre

M. GEORGE V. HAYTHORNE
sous-ministre

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Travailleurs de l'électricité et de l'électronique

Carrières dans les sciences naturelles

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Les techniciens en science et en génie

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ANCIEN FORMAT (QUANTITÉ LIMITÉE) .... PRIX 15c.

Charpentier-menuisier

Emplois ferroviaires

Soudeur

Carrières dans l'économie domestique

Instituteur

Les envois de fonds doivent être faits par chèque ou mandat-poste payable au Receveur général du Canada et adressés à:

L'IMPRIMEUR DE LA REINE
Ottawa, Canada

FILMS FIXES SUR LES OCCUPATIONS AU CANADA

Jusqu'ici, le ministère du Travail, en collaboration avec l'Office national du film, a produit les films fixes ci-dessous sur les occupations. Un manuel a été préparé pour accompagner chaque film. On peut les acheter en s'adressant à l'Office national du film, C.P. 6100, Montréal, ou à ses bureaux régionaux. Prix au Canada: en noir et blanc $2; en couleur, $4.

Plombier, tuyauteur et appareilleur à vapeur (n. & b.)

Carrières dans le génie (en couleur)

Travailleur social (n. & b.)

Travailleur de l'électricité et de l'électronique (en couleur)

Briqueteur et maçon (n. & b.)

Métiers de l'imprimerie (n. & b.)

Mécanicien d'auto (n. & b.)

Carrières dans l'économie domestique

Emplois miniers (n. & b.)

Dessinateur (n. & b.)

Emplois dans la construction (n. & b.)

Occupations dans les ateliers mécaniques (n. & b.)

Tôlier (n. & b.)

Carrières dans la météorologie (n. & b.)

Technologiste médical (en couleur)

Instituteur (en couleur)

Emplois de bureau (en couleur)

Carrières dans les bibliothèques (en couleur)

LES TECHNICIENS

EN SCIENCES ET EN GÉNIE

Recherche

Inspection

Installation

Enseignement

Vente et service

Dessin et perfectionnement

Fonctionnement et entretien

Organisation de la production